DOCUMENT RESUME

ED 445 199 CE 080 647

| | |
|---|---|
| TITLE | Making Standards Work! Science. A Teacher's Guide to Contextual Learning: Integrating Academic Content Standards with Career Development and Workplace Competencies. |
| INSTITUTION | Colorado State Dept. of Education, Denver.; Colorado School to Career Partnership, Denver. |
| PUB DATE | 2000-00-00 |
| NOTE | 119p.; Developed and edited by Susan McAlonan, Heather Hotchkiss, Kelli Roark, Lucinda Howe, Joy Fitzgerald, Christine Nichols and Gail Smith. For related guides, see ED 425 329 (Mathematics), ED 431 761 (Reading and Writing) and CE 080 750 (History). |
| AVAILABLE FROM | Career & Technical Education Resource Center of Colorado, 1059 Yosemite Street, Bldg. 758, Room 117, Aurora, CO 80010, Tel: 303-340-7350, Fax: 303-340-7353, E-mail: cterc@ccs.cccoes.edu, Web site: http://www.cterc@cccs.cccoes.edu/sales.htm ($18). |
| PUB TYPE | Guides - Classroom - Teacher (052) |
| EDRS PRICE | MF01/PC05 Plus Postage. |
| DESCRIPTORS | *Academic Standards; Career Development; *Career Education; Classroom Techniques; Competence; Competency Based Education; Context Effect; Delivery Systems; *Education Work Relationship; Educational Environment; Educational Strategies; Elementary Secondary Education; Employment Qualifications; Evaluation Methods; Guidelines; *Integrated Curriculum; Job Skills; Learning Activities; Matrices; Partnerships in Education; Performance Based Assessment; Performance Factors; School Business Relationship; *Science Education; Scoring Rubrics; Special Needs Students; *State Standards; Statewide Planning; Student Evaluation; Success; Teaching Guides |
| IDENTIFIERS | *Colorado; *Contextual Learning; Contextualized Instruction; Contextualized Learning Environments |

ABSTRACT

This guide, which was written by Colorado educators, is intended to help other educators in Colorado weave academic content standards regarding science, assessments, and school-to-career methods into an integrated, comprehensive strategy for preparing all students to meet their future goals. The introduction discusses the guide's purpose, the role of standards and assessments in the context of a changing workplace, the Colorado School-to-Career Partnership, and the guide's structure and content. Section 1 presents the Colorado General Workplace Competencies, which describe the skills and knowledge needed for school and career success and which are organized into the following categories: communication; organization; thinking; technology; and worker qualities. Section 2 offers guidelines for helping special populations of students meet academic content standards while participating in school-to-career opportunities. Section 3 features 18 integration matrices and 18 classroom activities for integrating science standards with workplace competencies. One matrix and one activity are provided for each standard for students in grades K-4, 5-8, and 9-12. Section 4 presents three sample rubrics that are aligned with the integrated learning activities contained in Section 3 and designed to assess the skills

Reproductions supplied by EDRS are the best that can be made
from the original document.

and knowledge of students in grades K-4, 5-8, and 9-12. The addresses of Colorado's six school-to-career regional resource centers are listed. (MN)

Reproductions supplied by EDRS are the best that can be made
from the original document.

ED 445 199

# MAKING STANDARDS WORK!

A TEACHER'S GUIDE TO CONTEXTUAL LEARNING:
INTEGRATING ACADEMIC CONTENT STANDARDS
WITH CAREER DEVELOPMENT AND
WORKPLACE COMPETENCIES.

CE 080647

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
X This document has been reproduced as received from the person or organization originating it.
Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

N Bolt

Developed By . . .
*The Colorado Department of Education*

In Conjuction With . . .
*The Colorado School-to-Career Partnership*

BEST COPY AVAILABLE

*"All of us have a stake, as individuals and as a society, in scientific literacy. An understanding of science makes it possible for everyone to share in the richness and excitement of comprehending the natural world. Scientific literacy enables people to use scientific principles and processes in making personal decisions and to participate in discussions of scientific issues that affect society. A sound grounding in science strengthens many of the skills that people use every day, like solving problems creatively, thinking critically, working cooperatively in teams, using technology effectively, and valuing life-long learning. And the economic productivity of our society is tightly linked to the scientific and technological skills of our work force."*

*- **Call to Action**,*
*National Science Education Standards, p. ix.*
*copyright 1996 by the National Academy of Sciences*
*Courtesy of the National Academy Press, Washington, D.C.*



# COLORADO STATE BOARD OF EDUCATION

*""Elected to lead, to serve, and to promote quality education for all"*
*Seated January 1999*

| | |
|---|---|
| **Clair Orr**<br>Chairman | 4th Congressional District<br>*Kersey* |
| **Patricia M. Chlouber**<br>Vice Chairman | 3rd Congressional District<br>*Leadville* |
| **Ben L. Alexander** | Member-at-Large<br>*Montrose* |
| **John Burnett** | 6th Congressional District<br>*Colorado Springs* |
| **Randy DeHoff** | 5th Congressional District<br>*Littleton* |
| **Patti Johnson** | 2nd Congressional District<br>*Broomfield* |
| **Gully Stanford** | 1st Congressional District<br>*Denver* |
| **William Moloney** | Colorado Commissioner of Education |

# MAKING STANDARDS WORK
## ACKNOWLEDGEMENTS


### DEVELOPED AND EDITED BY:

| | |
|---|---|
| Susan McAlonan | Colorado Department of Education |
| Heather Hotchkiss | Colorado Department of Education |
| Kelli Roark | Colorado Department of Education |
| Lucinda Howe | Consultant |
| Joy Fitzgerald | Consultant |
| Christine Nichols | Consultant |
| Gail Smith | Consultant |

### PUBLICATION DESIGNED BY:

Janet L. Roucis, State of the Art Graphics

### CLASSROOM ACTIVITIES DEVELOPED BY:

| | |
|---|---|
| Diane Bergeron | Jefferson County R-1 |
| Cecily Brown | Jefferson County R-1 |
| Steve Campbell | Thompson R-2J |
| Lavone Haskins | Summit RE-1 |
| Mary Lindimore | Jefferson County R-1 |
| Frank Mayhue | Adams-Arapahoe 28J |
| Peggy McCoy | Mapleton 1 |
| Raylene Owen | Cherry Creek 5 |
| Jed Palmer | Sheridan 2 |
| Kelly Roberts | Cherry Creek 5 |
| Jennifer Salvador | Lutheran Medical Center |
| Lisa Schneider | Jefferson County R-1 |
| Mark Woodworth | Jefferson County R-1 |

### SPECIAL THANKS TO . . .

- Colorado Department of Education
- Colorado School-to-Career Partnership
- Colorado Association of Commerce & Industry
- General and special education teachers, students, counselors, administrators and business partners who contributed to and supported this project
- Gail Smith for the rubrics.

# TABLE OF CONTENTS


Page

Colorado State Board of Education . . . . . i

Acknowledgements . . . . . ii

Introduction . . . . . 1

Workplace Competencies . . . . . 3

*Opportunities for Success* . . . . . 4

## INTEGRATION MATRICES AND CLASSROOM ACTIVITIES

### INTEGRATING SCIENCE STANDARDS WITH WORKPLACE COMPETENCIES

**Grades K-4**

Standard 1: Integration Matrix . . . . . 10a
Classroom Activity . . . . . 10b
Standard 2: Integration Matrix . . . . . 11a
Classroom Activity . . . . . 11b
Standard 3: Integration Matrix . . . . . 12a
Classroom Activity . . . . . 12b
Standard 4: Integration Matrix . . . . . 13a
Classroom Activity . . . . . 13b
Standard 5: Integration Matrix . . . . . 14a
Classroom Activity . . . . . 14b
Standard 6: Integration Matrix . . . . . 15a
Classroom Activity . . . . . 15b

**Grades 5-8**

Standard 1: Integration Matrix . . . . . 16a
Classroom Activity . . . . . 16b
Standard 2: Integration Matrix . . . . . 17a
Classroom Activity . . . . . 17b
Standard 3: Integration Matrix . . . . . 18a
Classroom Activity . . . . . 18b
Standard 4: Integration Matrix . . . . . 19a
Classroom Activity . . . . . 19b
Standard 5: Integration Matrix . . . . . 20a
Classroom Activity . . . . . 20b
Standard 6: Integration Matrix . . . . . 21a
Classroom Activity . . . . . 21b

**Grades 9-12**

Standard 1: Integration Matrix . . . . . 22a
Classroom Activity . . . . . 22b
Standard 2: Integration Matrix . . . . . 23a
Classroom Activity . . . . . 23b
Standard 3: Integration Matrix . . . . . 24a
Classroom Activity . . . . . 24b
Standard 4: Integration Matrix . . . . . 25a
Classroom Activity . . . . . 25b
Standard 5: Integration Matrix . . . . . 26a
Classroom Activity . . . . . 26b
Standard 6: Integration Matrix . . . . . 27a
Classroom Activity . . . . . 27b

Sample Rubrics . . . . . 28-30

School-to-Career Regional Resource Centers . . . . . 31

Handbook Evaluation . . . . . 32

# INTRODUCTION

As educators we strive to reach every student in our classrooms. We measure our success when students grasp a new concept, move successfully to the next grade level or achieve recognition for their skills and abilities. However, the ultimate test is often when we see former students as adults. We want to know about college, their job and family and if they are happy with their lives. When students are successful, we are proud of the role we played in their development. When students struggle with the transition from school to post-secondary education and/or work, we often step back and reflect: Did we do enough to prepare students for life after school? What makes the difference between those students who are successful and those who are not?

***Making Standards Work*** is a tool to help educators weave academic content standards, assessments and school-to-career methods into an integrated and comprehensive educational strategy that prepares all students to meet their future goals. The examples contained in this publication were created by Colorado educators to provide a vision of how teachers can deliver instruction in ways that help students reach high academic standards, develop effective work habits and gain career knowledge.

**Standards and Assessment**

Colorado enacted legislation in 1993 to adopt a standards-driven system of education. Public support for this reform is high and 48 other states have developed, or are in the process of developing, standards for what students should know and be able to do at various points in their schooling.

Standards-driven reform is based on the premise that students can achieve more if the expectations for learning are clearly defined, if students know in advance the criteria for meeting those expectations and if teaching and assessment support the expectations and reinforce student effort. Standards enhance accountability by focusing on student results, not on the curriculum, educational program or other "inputs" used by a particular school.

Colorado's model content standards represent the consensus of thousands of parents, educators, administrators, employers and interested community members. The standards were developed through a two-year process that involved three publicly reviewed drafts, approximately 10,000 responses to these drafts and a series of regional meetings across the state.

The standards reflect a "thinking" curriculum - one that requires students to know basic skills, to communicate effectively to solve problems, and to understand and apply academic principles and tools. They define a set of skills and knowledge that will prepare Colorado students for employment, citizenship and life-long learning in the new century.

**Changes in the Workplace**

The national economy is undergoing major changes that have an impact on both the opportunities available to workers and the expectations and needs of their employers:

- The number of jobs that employ unskilled workers is rapidly diminishing. Those jobs that do exist increasingly fail to pay a living wage.
- The income gaps among workers who dropped out of high school, those who graduated from high school, those who have an associate degree and those with a bachelor's degree are significant and growing.
- New technologies and services continue to emerge rapidly. Nearly 50% of employers use equipment less than four years old. On average, 42% of non-managerial employers now use computers in their work.
- The growth of new information and knowledge is exploding, doubling in a span of ten to fifteen years.

Schools must change as well to ensure that they are preparing students who can succeed in this dynamic environment.

**Colorado School-to-Career Partnership**

The Colorado School-to-Career Partnership is a statewide effort assisting local schools and communities to develop a K-16 learning system that promotes attainment of high academic standards, career development and workforce preparation for every student.

Academics and career development are integrated in classrooms and worksite experiences, and aligned with content standards and assessment. There are currently 91 local School-to-Career Partnerships in Colorado representing 144 school districts. An estimated 209,000 K-16 students have already participated in one or more school-to-career activities and the momentum continues to build in communities around our state.

**Using this Handbook**

*Making Standards Work* is divided into four sections:

I. Workplace Competencies: This section presents the Colorado General Workplace Competencies, which were developed by a business task force of the Colorado Association of Commerce and Industry. These competencies describe the skills and knowledge students need to be successful in most careers and in college. The competencies are organized into the following categories:
   - Communication
   - Organization
   - Thinking
   - Technology
   - Worker Qualities

   **These workplace competencies must be intentionally taught and assessed to assist students in transferring classroom learning to the world of work and to post-secondary education.**



II. *Opportunities for Success*: This section offers guidelines for educators as they help special populations of students, who have diverse and sometimes very unique needs, meet academic content standards and participate in school-to-career opportunities.

> In Colorado, Access Skills are those skills that all students must demonstrate in order to succeed with academic content standards and in the workplace. Access Skills are a combination of the Colorado General Workplace Competencies and the Essential Learning Principles defined in *Opportunities for Success*.

III. Integration Matrices and Classroom Activities: This section features grids that provide examples of how the Colorado General Workplace Competencies cross-reference with the Colorado Model Content Standards for science. To help educators think about how to integrate the workplace competencies into their science instruction, the grids are followed by examples of classroom strategies that combine a specific academic content standard, career development activity, general workplace competency and assessment strategy.

   Quotes and Resources: Through the quotations, Colorado educators, business leaders and students (with parental consent) offer their perspectives on integrating workplace competencies and academic content standards. The featured resources provide a starting point in locating additional integrated curriculum, work-based learning opportunities or connecting activities. They also may offer helpful information for expanding current educational strategies.

   **Activities and resources included in this handbook are intended for use at the discretion of local districts. They have not been endorsed or ratified by any official Colorado State body.**

IV. Sample Rubric: A rubric is a descriptive measurement for determining what a student knows and can do. Assessment rubrics, aligned with the integrated learning activities on pages 13b, 16b and 22b, are included. Educators can use this example to create additional rubrics to assess student learning.

# I. WORKPLACE COMPETENCIES

The Colorado General Workplace Competencies were developed by a business task force of the Colorado Association of Commerce and Industry, in conjunction with the Colorado Department of Education and the Colorado School-to-Career Partnership. These competencies represent the skills that post-secondary students and workers need in most jobs regardless of the specific occupational area.

These competencies will help educators and students understand the skills and knowledge students need to succeed in higher education and the workforce. The competencies also provide Colorado businesses with a consistent set of standards that promote a skilled workforce.

**Communication Skills** - Demonstrates the ability to receive and relay information clearly and effectively

Listening - receives, attends to, understands and responds to verbal and non-verbal messages
Speaking - clearly organizes and effectively presents ideas orally
Reading - locates, understands and interprets written information in prose and documents to perform tasks
Writing - organizes and effectively presents ideas and information in writing
Interpreting - delineates and analyzes oral and written information and synthesizes information into a conclusion
Negotiating - works toward agreement while maintaining position
Persuading - communicates ideas to justify position, overcome resistance and convince others



**Organizational Skills** - Demonstrates the ability to work effectively and efficiently

Planning - devises and outlines a process to achieve a goal and timeline
Time Management - applies appropriate time to task and manages multiple priorities
Using Resources - identifies, organizes, plans and allocates resources
Systems Thinking - understands the nature of systems, develops and adapts systems to meet organizational needs
Evaluating - collects, evaluates and uses data to monitor and improve performance

**Thinking Skills** - Demonstrates the ability to use reasoning

Problem Solving - identifies and recognizes a problem, considers alternatives, devises and implements a logical plan of action
Decision Making - uses a process to identify goals and constraints, evaluates alternatives and reaches a conclusion
Creative Thinking - generates new and innovative ideas
Learning - uses efficient techniques to acquire and apply new knowledge and skills
Analyzing - identifies bias of information sources, evaluates contradictory information and effectively manages information
Mathematics - performs basic computations and solves practical problems by applying appropriate mathematical techniques

**Worker Qualities** - Demonstrates the characteristics of an effective worker

Self-Management - demonstrates punctuality, readiness to work, initiative and the capacity for life long learning and personal growth
Team Member - contributes to group effort through cooperation and consensus
Responsibility - follows through consistently with honesty and integrity
Flexibility - shows versatility and the ability to change
Leadership - creates a direction/vision for others to follow, aligns management methods with vision and implements a system of accountability
Works with Diversity - accepts differences and works well with individuals from a variety of backgrounds and/or with divergent philosophies or ideas

**Technology Skills** - Demonstrates the ability to work with a variety of technologies and equipment

Demonstrates Computer Literacy - uses keyboarding skills, computer programs and understands basic computer operations
Selects Technology - chooses appropriate procedures, tools or equipment
Applies Technology - understands overall intent of and proper procedures for using selected technology and equipment
Uses Technical Information - interprets and uses data generated from a variety of technological devices

Note: Technology refers to any device, tool or piece of equipment that facilitates or supports efficient completion of work, including machinery, computers, scientific equipment, fax machines, voice mail, overhead projectors, VCRs, cash registers, and calculators.



# II. OPPORTUNITIES FOR SUCCESS

## GUIDELINES FOR BRINGING OUT THE BEST IN ALL OF OUR STUDENTS

"*Opportunities for Success*" was created through a process that engaged over 2,100 Colorado educators, parents and citizens from across the state and drew on the expertise of national professional organizations. Its purpose is to provide guidelines for educators as they help special populations of students, who have diverse and sometimes very unique needs, meet academic content standards.

These guidelines may be useful to:

- Curriculum directors as they coordinate and develop curriculum and instruction around standards
- Classroom teachers as they plan for their students
- Assessment professionals as they develop district and classroom assessments
- Building level planning committees as they work on school improvement efforts

### A. GENERAL PRINCIPLES

The four areas described below (Essential Learnings, Classroom Practices, Assessment Practices and Service Options) are designed to assist special needs students gain the skills necessary to reach high academic standards.

**Essential Learnings** - the knowledge and skills that special needs students require to maximize their educational growth and development.

*Students who are diverse learners need to learn:*

1. Communication skills to express and understand thoughts and opinions in a variety of settings, situations and with diverse populations.

2. Decision making and problem solving skills and strategies.

3. Basic language skills and a broad vocabulary to use as building blocks in developing reading, writing and critical thinking.

4. Self-advocacy skills to make their needs and wants known in socially constructive ways in learning, work and social situations.

5. Personal strengths and capabilities and the ability to use this knowledge to act responsibly at school and work.

6. Social skills to develop positive relationships with peers and adults in a variety of settings and situations and with diverse populations.

7. Organizational skills and study strategies for school and work. Important skills include, but are not limited to:
   - Time management
   - Goal setting
   - Management and use of materials/resources
   - Learning strategies

8. Career development skills to make, pursue and maintain personal employment choices.

9. The use of tools and technology to augment learning and access information.



**Classroom Practices** - the range of instructional practices and strategies that teachers employ to help a special population of students learn. These include, but are not limited to:

- Time
- Space
- Modality
- Grouping
- Presentation
- Classroom organization and behavior management
- Materials
- Equipment
- Technology
- Environment

*With the needs of diverse learners in mind, educators need to employ appropriate:*

1. Student Self-Management Strategies
   - Use strategies designed to promote student self-management and independence.
   - Provide consistency, structure and clear expectations.
   - Provide appropriate positive learning reinforcement, feedback and recognition for student accomplishment.

2. Setting for Instruction and Learning
   - Promote supportive and responsive climates that facilitate social and cultural learning and allow students to take risks and learn from failure.
   - Provide opportunities and environments that allow all students to participate meaningfully in instructional and social activities.
   - Adapt physical environments to match the learning needs of students.

3. Instructional Practice

- Incorporate life skills, social and affective skills and self-advocacy skills throughout the curriculum.
- Choose teaching and learning methods that match the learning needs and styles of the students.
- Incorporate direct instruction of how-to-learn skills and thinking skills throughout the curriculum.
- Ensure the language of instruction effectively communicates and promotes student understanding for students with special needs.
- Use methods to promote active learning, including hands-on learning, real-world and experiential learning, community-based learning and learning involving student choice.
- Use learning materials, equipment and media tailored to the unique learning needs of students.
- Design and implement specific opportunities for students to apply and transfer learning to a variety of situations, both familiar and new.
- Use varied and flexible grouping strategies for instructional purposes.
- Use flexibility in pacing instruction, scheduling and the use of time based on the needs of individual students.
- Communicate and collaborate with other teachers, specialists, students, families and appropriate agencies in planning and implementing effective instruction.



**Assessment Practices** - the accommodations and adaptations necessary for a special population to adequately demonstrate knowledge and skills.

*In assessing the learning of diverse learners, educators need to:*

1. Allow for a variety of assessments that evaluate what is being taught, including:
   - Portfolios
   - Assessment of daily work
   - Observations
   - Self and peer evaluations
   - Demonstrations and projects
   - Oral tests
   - Cooperative group assessments
   - Family, community and employer evaluations/observations
2. Ensure that the language used in assessment is consistent with the language used during instruction and reflects the student's preferred mode of communication, considering the:
   - Student's culture/preferred language
   - Clarity of instructions
   - Verbal and non-verbal options (i.e., sign language)
3. Consider the student's unique needs when determining the content of the assessment.
   - Identify the skills and content to be assessed and ensure that assessments test only the content that was taught.
   - Design assessments to determine what the student knows as opposed to what the student does not know.

- Utilize student's prior knowledge to determine instruction and subsequent assessments.
- Identify individual learning styles and design assessments to elicit a variety of thinking and application skills.

4. Design assessment procedures and accommodations to meet individual student needs.
   - Assess in the student's primary communication mode (i.e., Braille, sign language, picture board).
   - Use a variety of people (i.e., family, peers, employers, other professionals) in the assessment process.
   - Use technology for presentation of assessment and student response.
5. Allow flexibility in the time and scheduling of assessments.
   - Allow extended time.
   - Allow the student to take breaks.
   - Divide assessments into smaller segments.
   - Schedule assessments when students can perform best.
   - Use untimed assessments.



6. Allow for a variety of assessment environments. Consider the purpose of the assessment and the student's unique needs and choose the environment that fits best.
   - Consider the student's physical condition, endurance, attention span, distractibility, emotional state and medical condition, at the time of assessment.
   - Control for distractions.
   - Create supportive settings that encourage student participation.
   - Use preferential seating.
   - Use real life settings and other alternative environments.
7. Consider the evaluation criteria that will be used when designing assessments and set the criteria prior to assessment.
   - Involve others in determining realistic expectations and goals for the student.
   - Provide family and others the opportunity to assist in interpreting assessment results.
   - Make expectations and criteria clear and explicit.
   - Provide a variety of grading methods, including:
     - Individual grading scale
     - Narrative reports
     - Group grades

**Service Options** - systems of organizing people and materials to supply and deliver educational opportunities, accommodations and supports in order for students or given populations to become successful learners.

*For diverse learners to have adequate opportunities to learn, schools will:*

1. Involve families, community members and peers integrally in the design and implementation of educational services for all children and youth.

2. Use shared and flexible resources, including personnel, money, facility, program, time and administrative processes to meet students' needs and to offer appropriate services by providers with specific expertise.

3. Offer curriculum and instruction that is diversified through a variety of modifications, including alternative scheduling, accessibility, optimal learning environments, grouping, accommodation of multiple learning styles, setting appropriate expectations, student-teacher ratios and a variety of instructional techniques.

4. Support collaborative planning with individual students, team members, family members, the community and other agencies with the management of time and resources.

5. Design support services for students that help them with life management, including safety, health, wellness, social relationships and learning.

6. Assure students the opportunity to plan and prepare for successful life adjustment after high school, including career development, community involvement, post-secondary education, recreation and leisure choices, and daily living activities.

7. Maximize the use of technology for learning. School professionals, families, and students use technology competently.



8. Offer a menu of educational opportunities to students, families and school personnel for continuous improvement of services to students.

9. Offer support services to assist students in managing behavior, expressing needs, developing friendships, resolving conflicts, making choices and planning their lives.

## B. ADAPTATIONS

Adaptations are changes made to the environment, curriculum, instruction and/or assessment practices in order to help a student become a successful learner. Adaptations are based on the strengths and needs of individual students and may vary in intensity and degree.

Adaptations include:

1. **Accommodations:**
   Accommodations are adjustments made in *how* a student accesses and demonstrates learning. They do not substantially change the instructional level, content or the performance criteria. The changes are made in order to provide students equal access to learning and an equal opportunity to demonstrate what they know. Accommodations include changes in and/or provisions for the following:

   - Presentation and/or response format and procedures
   - Instructional strategies
   - Time/scheduling
   - Attitudes
   - Architecture
   - Environment
   - Equipment

2. **Modifications**:
   Modifications are substantial changes in *what* a student is expected to learn and demonstrate. They are made to provide students with opportunities to participate meaningfully and productively in learning experiences and environments. Modifications include changes in the following:
   - Instructional level
   - Content
   - Performance criteria

** Note: Under Colorado Law 22-7-407 et. seq. C.R.S., a student must have a Special Education Individualized Education Plan (IEP) to qualify for modifications to the standards, unless the modifications exceed those of district/state content standards.*

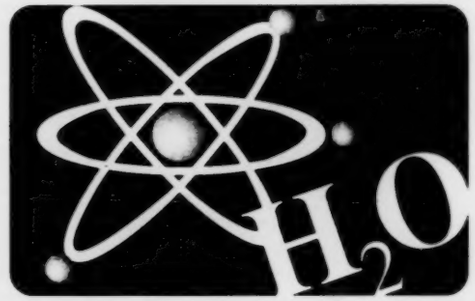


*Opportunities for Success* contains many strategies for specific special population groups including:

- Attention Deficit Disorder
- Chapter I (Title 1)
- Deaf/Blind
- Deaf/Hearing Impaired
- Gender
- Gifted Individuals
- Language Minority Students
- Learning Disabilities (Perceptual/Communicative)
- Migrant Students
- Physically Disabled and 504
- Prevention Initiatives (High-Risk)
- Race
- Significant Cognitive Challenges
- Significant Identifiable Emotional Disabilities
- Speech/Language Needs
- Traumatic Brain Injury
- Visual Disabilities

The complete version of *Opportunities for Success* can be purchased for $18.00 by contacting:
The Colorado Department of Education
Special Education Services Unit
(303) 866-6690

# GRADES K-4




## III. INTEGRATION MATRICES AND CLASSROOM ACTIVITIES

INTEGRATING SCIENCE STANDARDS
WITH WORKPLACE COMPETENCIES

# SCIENCE

## Academic Content Standard

1. Students understand the processes of scientific investigation and design, conduct, and can communicate about and evaluate such investigations.

### Workplace Competencies

| GRADES K-4 BENCHMARKS | COMMUNICATION SKILLS: Demonstrates the ability to receive and relay information clearly and effectively | | | | | | | ORGANIZATIONAL SKILLS: Demonstrates skills to effectively and efficiently operate within a workplace | | | | | | THINKING SKILLS: Demonstrates the ability to use reasoning | | | | | | TECHNOLOGY SKILLS: Demonstrates the ability to work with a variety of technologies | | | | WORKER QUALITIES: Demonstrates the characteristics of an effective worker | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Listening | Speaking | Reading | Writing | Interpreting | Negotiating | Persuading | Planning | Time Management | Using Resources | Systems Thinking | Evaluating | Problem Solving | Decision Making | Creative Thinking | Learning | Analyzing | Mathematics | Computer Literacy | Selects Technology | Applies Technology | Uses Technical Info. | Self Management | Team Member | Responsibility | Flexibility | Leadership | Diversity |
| a. asking questions and stating predictions (hypotheses) that can be addressed through scientific investigation | ● | ● | | | ● | | ● | | ● | | | | | ● | | | | | | | | | | ● | | | | |
| b. selecting and using simple devices to gather data related to an investigation | | | ● | | | | | ● | ● | | | | ● | | ● | | | | * | ● | | | | ● | | ● | | |
| c. using data based on observations to construct a reasonable explanation | | | ● | | ● | | | | | ● | | | ● | | | | | | | | | | | | | | | |
| d. communicating about investigations and explanations | | | ● | ● | ● | | | | | | | ● | | | | | | ● | | | | | | | | | | |

K-4

GRADE LEVEL

K 1 2 3 4 5 6 7 8 9 10 11 12

**STATE STANDARD**

1. Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.

**BENCHMARK**

b. selecting and using simple devices to gather data related to an investigation

**WORKPLACE COMPETENCY**

Technology Skills: Selects Technology chooses appropriate procedures, tools, or equipment

## RESOURCE

Eisenhower National Clearinghouse (ENC) offers K-12 teachers and other educators free information about mathematics and science curriculum resources available through the Internet or toll-free modem access to ENC Online, in print and on CD-ROM.

Eisenhower National Clearinghouse
1929 Kenny Road
Columbus, OH 43210-1079
800/621-5785
614/292-2066 (fax)
800/362-4448 (modem)
info@enc.org (e-mail)
http://www.enc.org



# SCIENCE

## LEARNING ACTIVITIES

### ACADEMIC CONTENT STANDARD

Students select five objects to measure and weigh. The students then predict the measurements and weights of the five objects and classification (such as which object is the largest, which is the smallest, heaviest and lightest) and record their guesses. Students then measure and weigh the five objects and record the actual results using a data table and a graph. Students then write a statement about the accuracy of their predictions and the actual weight and measurement of the objects.

### WORKPLACE COMPETENCY

#### TECHNOLOGY SKILLS: SELECTS TECHNOLOGY

Students choose the appropriate measuring device for the object or distance they are going to measure and discuss the advantages and constraints of each device (i.e., using a ruler to measure the length of the room or using a meter stick to measure the thickness of a piece of paper).

### CAREER DEVELOPMENT

Invite a cartographer, civil engineer or surveyor to talk to the class about the tools they use for measurement and the skills and training needed in their career. The speaker can also discuss the impact of technology.

### COMMUNITY

Students create a school map/community map or check their current map for accuracy and suggest any changes that may be needed.

## ASSESSMENTS

### ACADEMIC CONTENT STANDARD

Evaluate students on:

- the accuracy of their measurements
- the presentation of their data table and graph
- the accuracy of their written statement.

### WORKPLACE COMPETENCY

#### TECHNOLOGY SKILLS: SELECTS TECHNOLOGY

Evaluate students on their ability to:

- select the most appropriate measuring tool to measure a wide variety of objects
- identify advantages and constraints of each measuring device.

# SCIENCE

## Academic Content Standard

2. Physical Science: Students know and understand common properties, forms and changes in matter and energy.

2.1 Students know that matter has characteristic properties, which are related to its composition and structure.

## Workplace Competencies

| GRADES K-4 BENCHMARKS | COMMUNICATION SKILLS: Demonstrates the ability to receive and relay information clearly and effectively | | | | | | | ORGANIZATIONAL SKILLS: Demonstrates skills to effectively and efficiently operate within a workplace | | | | | | | THINKING SKILLS: Demonstrates the ability to use reasoning | | | | | | | TECHNOLOGY SKILLS: Demonstrates the ability to work with a variety of technologies | | | | WORKER QUALITIES: Demonstrates the characteristics of an effective worker | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Listening | Speaking | Reading | Writing | Interpreting | Negotiating | Persuading | Planning | Time Management | Using Resources | Systems Thinking | Evaluating | Problem Solving | Decision Making | Creative Thinking | Learning | Analyzing | Mathematics | Computer Literacy | Selects Technology | Applies Technology | Uses Technical Info. | Self Management | Team Member | Responsibility | Flexibility | Leadership | Diversity |
| a. examining, describing, classifying, and comparing tangible objects in terms of common physical properties | | | ● | ● | ● | | | | | ● | ● | | ● | ● | ● | ● | | | | ● | | | | | | | | |
| b. measuring common physical properties of objects | | | | | | | | | | ● | | ● | | | ● | * | ● | | | ● | | ● | | | | | | |
| c. creating mixtures and separating them based on differences in properties | | | | ● | | | | | | ● | ● | ● | ● | | ● | | | | | | | | | | | | | |

K-4

GRADE LEVEL

K 1 2 3 4 5 6 7 8 9 10 11 12

**STATE STANDARD**

2. Physical Science: Students know and understand common properties, forms, and changes in matter and energy.
   2.1 Students know that matter has characteristic properties, which are related to its composition and structure.

**BENCHMARK**

b. measuring common physical properties of objects

**WORKPLACE COMPETENCY**

Thinking Skills: Analyzing
identifies bias of information sources, evaluates contradictory information and effectively manages information

## QUOTATION

"This (math) knowledge will help me in the real world and my favorite subject: Science."

- Brad, 4th Grade



# SCIENCE

## LEARNING ACTIVITIES

### ACADEMIC CONTENT STANDARD

Teacher discusses/describes the three states of matter: solid, liquid and gas and how matter is measured by its volume and weight. Students then make ice cream in the classroom to observe the change in state from liquid to solid. Students observe and record changes in the state of ice cream at different temperatures by keeping track of temperature and volume.

### WORKPLACE COMPETENCY

#### THINKING SKILLS: ANALYZING

The concept of analyzing is explored and elements are listed by the class. Teacher presents what it means to analyze information by using the data (temperatures) collected from the ice cream experiment. The class then discusses the range of temperatures at which food is cooked and the possible reasons for the variation. Applying this framework to above activity, students analyze ice cream in various states and suggest possible explanations for those differences.

### CAREER DEVELOPMENT

- Students discuss why and how professionals in various fields analyze information.
- Invite a refrigeration specialist in to speak to the class about how refrigeration is created.
- Talk with a produce manager about what foods need to be refrigerated and why.

### COMMUNITY

Students take a study trip to a grocery store to identify the different temperatures at which food is kept and the way stores maintain these temperatures. The discussion may focus on how the store managers analyze information to make decisions about food storage and display.

## ASSESSMENTS

### ACADEMIC CONTENT STANDARD

Evaluate students on their ability to:

- identify factors that affect the state of ice cream (heat and cold)
- explain the different states of matter (liquid and solid)
- explain or demonstrate how different states of matter is measured
- describe why food products must be kept at certain temperatures.

### WORKPLACE COMPETENCY

#### THINKING SKILLS: ANALYZING

Evaluate the students on their ability to:

- define the word analyze
- identify information that gives possible causes and reasons
- determine when more information is needed
- give an example of how they have analyzed a situation
- identify why the skill of analyzing is important.

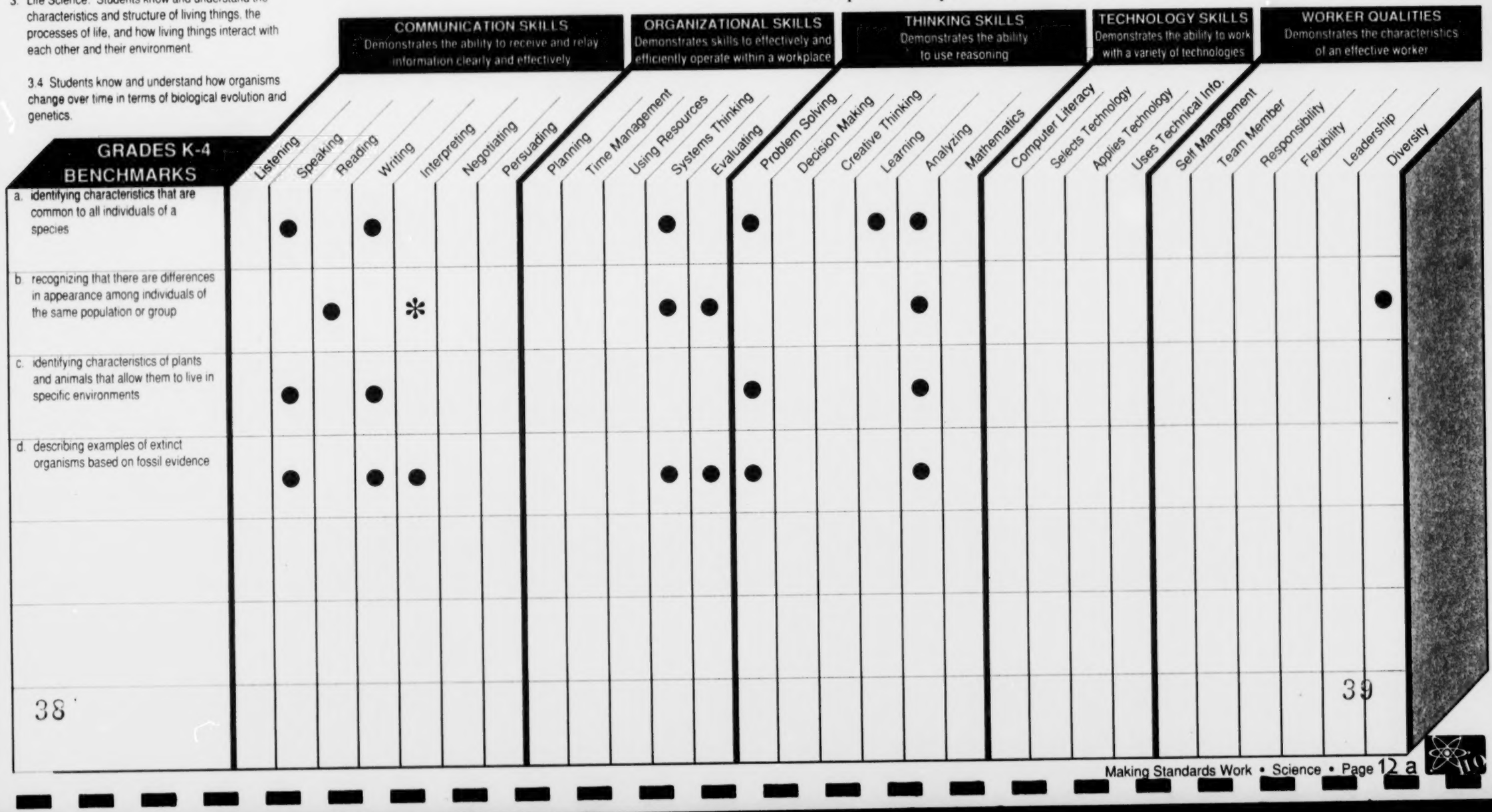
# SCIENCE

## Academic Content Standard

3. Life Science: Students know and understand the characteristics and structure of living things, the processes of life, and how living things interact with each other and their environment.

3.4 Students know and understand how organisms change over time in terms of biological evolution and genetics.

## Workplace Competencies



K-4

GRADE LEVEL

K 1 2 3 4 5 6 7 8 9 10 11 12

**STATE STANDARD**

3. Life Science: Students know and understand the characteristics and structure of living things, the processes of life, and how living things interact with each other and their environment.
   3.4 Students know and understand how organisms change over time in terms of biological evolution and genetics.

**BENCHMARK**

b. recognizing that there are differences in appearance among individuals of the same population or group

**WORKPLACE COMPETENCY**

Communication Skills: Interpreting delineates and analyzes oral and written information and synthesizes information into a conclusion

## RESOURCES

**The Denver Rocky Mountain News - in Education**

While other textbooks lose relevance soon after being printed, the newspaper is the only up-to-the-minute text available that brings life directly into your classroom. When you're part of the Denver Rocky Mountain News NIE program, you give your students this living textbook, with new information and photos--every day. With its convenient format, the Denver Rocky Mountain News reads like a book and fits on a desk.

**www.insidedenver.com/nie**

**The Denver Post - Newspaper In Education:**

Program components:

- Monthly resource packets
- Twice monthly faxed lesson plans with activities based on Colorado model content standards in language arts, history and math.
- Monthly special features in Colorado Kids on diversity issues.
- International pen pal opportunities

**www.denverpost.com/nie/nie.htm**



# SCIENCE

## LEARNING ACTIVITIES

### ACADEMIC CONTENT STANDARD

The class discusses how the same population or group (i.e., humans) may have different physical characteristics. Each student writes their own characteristics on a card (blonde hair, blue eyes, wears glasses, etc.) The teacher gathers the cards, mixes them up and selects a card at random. Reading off the characteristics, the class attempts to identify the classmate that fits the description.

### WORKPLACE COMPETENCY

#### COMMUNICATION SKILLS: INTERPRETING

The class discusses the skill of interpreting and identifies how it is used. Using the activity above, the class discusses and interprets which descriptors are most helpful and which are least helpful and why.

### CAREER DEVELOPMENT

Students write a letter (or e-mail) to a Colorado geneticist or "Ask a Scientist" regarding genetics as well as the education and/or training needed to enter the field and how interpreting is used.

### COMMUNITY

Students create a collage using pictures of themselves, community members, and from magazines to showcase the similarities and differences among us.

## ASSESSMENTS

### ACADEMIC CONTENT STANDARD

Evaluate the students on their ability to:

- identify characteristics of populations
- identify the similarities and differences of characteristics.

### WORKPLACE COMPETENCY

#### COMMUNICATION SKILLS: INTERPRETING

Evaluate the students on their ability to:

- define the skill of interpreting
- identify and analyze the utility of various descriptors
- reach and defend a conclusion regarding which descriptors are the most and least helpful.

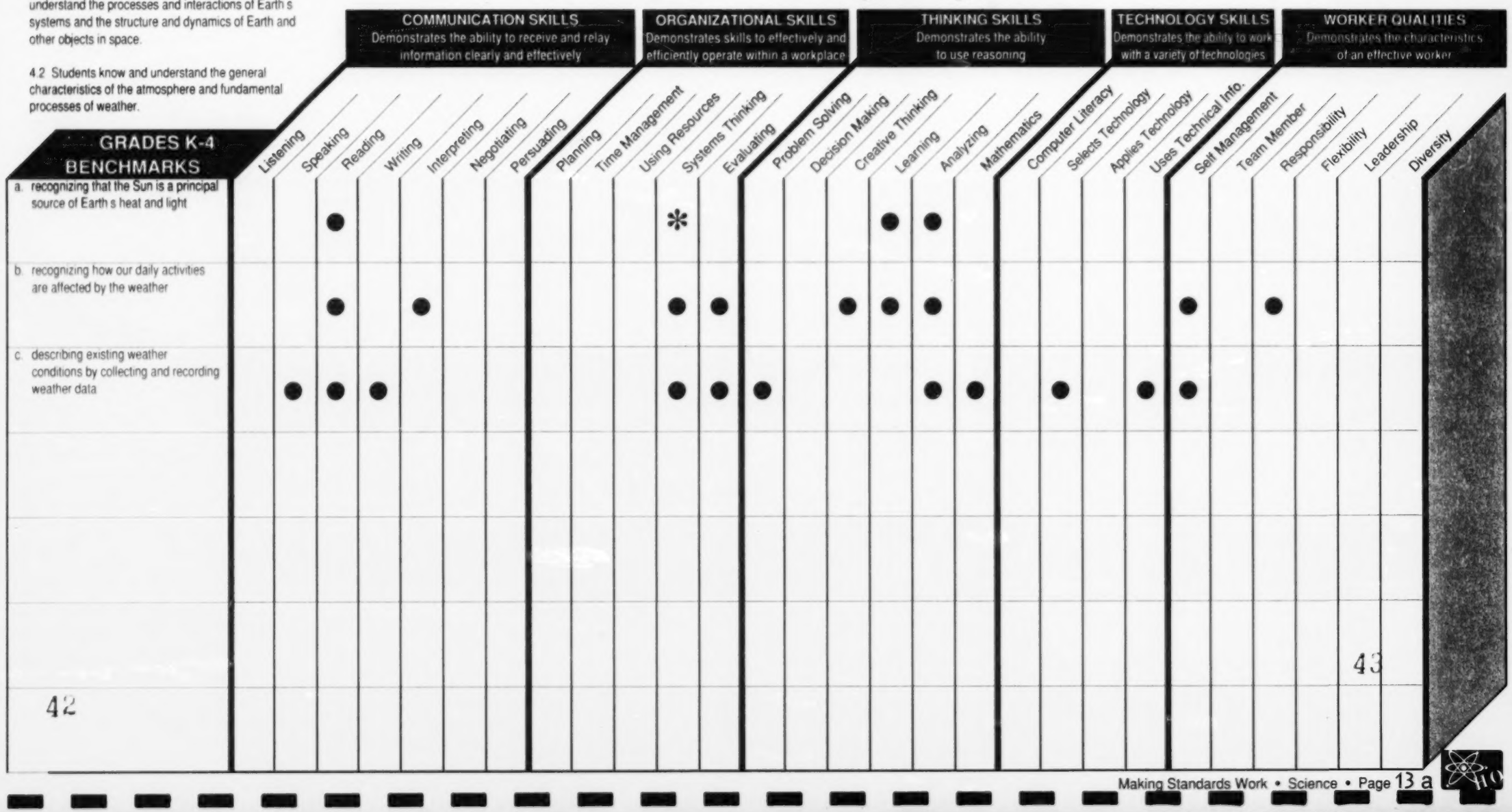
# SCIENCE

## Academic Content Standard

4. Earth and Space Science: Students know and understand the processes and interactions of Earth s systems and the structure and dynamics of Earth and other objects in space.

4.2 Students know and understand the general characteristics of the atmosphere and fundamental processes of weather.

## Workplace Competencies



K-4

GRADE LEVEL

K 1 2 3 4 5 6 7 8 9 10 11 12

**STATE STANDARD**

4. Earth and Space Science: Students know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.
   4.2 Students know and understand the general characteristics of the atmosphere and fundamental processes of weather.

**BENCHMARK**

a. recognizing that the Sun is a principal source of Earth's heat and light

**WORKPLACE COMPETENCY**

Organizational Skills: Systems Thinking understands the nature of systems, develops and adapts systems to meet organizational needs

## RESOURCE

**National Renewable Energy Lab (NREL)**

NREL's 300-acre campus is located at the foot of South Table Mountain in Golden, Colo. Major research facilities include: Solar Energy Research Facility — housing the National Center for Photovoltaics, Field Test Laboratory Building, Thermal Test Facility, Alternative Fuels User Facility and Process Development Unit, Solar Furnace and Solar Radiation Research Laboratory , National Wind Technology Center, and Thermochemical Users Facility. NREL's administrative offices occupy leased space in Denver West Office Park.

**www.nrel.gov**



# SCIENCE

## LEARNING ACTIVITIES

### ACADEMIC CONTENT STANDARD

Teacher presents the basic components of the solar system and its processes. Focusing on the sun, students determine the sun's attributes and its relationship to other planetary objects in the solar system. Students brainstorm and record the positive and negative influences the sun has on the earth. Students are given two paper cups filled with soil and a thermometer stuck in each. Students enclose one cup in a sealed plastic bag and then both cups are placed under a lamp (with 6-8 inches between the lamp and the cups).

Using a graph, students record the temperature of the air above the soil every 5 minutes for 30 minutes. Students predict what the temperature of the cup of soil in the sealed bag will be and the unsealed cup of soil. Students then compare the two temperatures and write a statement of their observations and a hypothesis about the differences and/or similarities in the data.

### WORKPLACE COMPETENCY

#### ORGANIZATIONAL SKILLS: SYSTEMS THINKING

As a class, discuss the characteristics of a system. Student predict some of the effects and the possible sequence of events if the Earth did not have a sun or if our atmosphere no longer filtered out some of the sun's rays. The class may use resources from the National Renewable Energy Lab in Golden, Colorado (see resource).

### CAREER DEVELOPMENT

- Invite a representative from the National Renewable Energy Lab to discuss the ozone layer and solar energy.
- Invite a weather reporter or meteorologist to discuss the sun's impact on our weather.

### COMMUNITY

- Students create a bulletin board of their learnings and display it in the school.
- Students monitor a school weather station and communicate data to the community.

## ASSESSMENTS

### ACADEMIC CONTENT STANDARD

Evaluate the students on their ability to:

- identify attributes of the sun and its relationship to other planetary objects
- identify positive and negative influences the sun has on the earth
- measure the air temperature accurately in the experiment
- record the data correctly.

### WORKPLACE COMPETENCY

#### ORGANIZATIONAL SKILLS: SYSTEMS THINKING

Evaluate the students on their ability to:

- identify the characteristics of a system
- predict the impact of changes in the atmosphere due to the sun
- describe a sequence of cause and effect.

### EXTENSIONS

Students research and create a pamphlet regarding the effects of the sun on our skin and the benefits of sunscreen. Students may also write an article for their local newspaper or school newsletter about the benefits of sunscreen.

# SCIENCE

## Academic Content Standard

5. Students know and understand interrelationships among science, technology, and human activity and how they can affect the world.

### Workplace Competencies

| GRADES K-4 BENCHMARKS | COMMUNICATION SKILLS: Demonstrates the ability to receive and relay information clearly and effectively | | | | | | | ORGANIZATIONAL SKILLS: Demonstrates skills to effectively and efficiently operate within a workplace | | | | | | | THINKING SKILLS: Demonstrates the ability to use reasoning | | | | | | TECHNOLOGY SKILLS: Demonstrates the ability to work with a variety of technologies | | | WORKER QUALITIES: Demonstrates the characteristics of an effective worker | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Listening | Speaking | Reading | Writing | Interpreting | Negotiating | Persuading | Planning | Time Management | Using Resources | Systems Thinking | Evaluating | Problem Solving | Decision Making | Creative Thinking | Learning | Analyzing | Mathematics | Computer Literacy | Selects Technology | Applies Technology | Uses Technical Info. | Self Management | Team Member | Responsibility | Flexibility | Leadership | Diversity |
| a. recognizing the diversity of resources provided by the Earth and Sun | | | ● | | ● | | | | | ● | | | | | ● | ● | | | | | | | | | ● | | | |
| b. inventing a device that addresses an everyday problem (or task), and communicating the problem (or task), design, and solution | | ● | ● | ● | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | | | | | | ● | | ● | | ● | ● |
| c. describing resource-related activities in which they could participate that can benefit their communities | | ● | ● | ● | | | ● | ● | | ● | ● | | ● | ● | | | | | | | | | ● | ● | ● | | | |
| d. identifying careers that use science and technology | | | ● | | | | | | ● | ● | ● | | | * | ● | ● | | | | | ● | | | ● | | | | |

K-4

GRADE LEVEL

K 1 2 3 4 5 6 7 8 9 10 11 12

**STATE STANDARD**

5. Students know and understand interrelationships among science, technology, and human activity and how they can affect the world.

**BENCHMARK**

d. identifying careers that use science and technology

**WORKPLACE COMPETENCY**

Thinking Skills: Creative Thinking
generates new and innovative ideas

## RESOURCE

The Center on Education and Work is a non-profit organization that provides a variety of resources for job seeking, career planning, occupational education, and special needs education through handbooks, workbooks, videotapes, and computer software materials.

Center on Education and Work
University of Wisconsin-Madison
School of Education
964 Educational Sciences Building
1025 W. Johnson Street
Madison, WI 53706
800/446-0399
608/262-9197 (Fax)
www.cew.wisc.edu





## LEARNING ACTIVITIES

### ACADEMIC CONTENT STANDARD

Students choose an adult in their life to interview (parent, grandparent, teacher) The interview questions must include the following areas:

- chosen career
- preparation/requirements for that career
- how does technological advances effect this career area
- are there any science related components of the career - if so, how
- are there technological implications or devices used and if they have changed and how
- how does the career interact with or effect the community.

### WORKPLACE COMPETENCY

#### THINKING SKILLS: CREATIVE THINKING

The concept of creativity is defined. Students design a creative presentation (poster, overheads, collage, role play, etc.) and present to the class. The presentation must include the interview information and identify at least 3 other career areas that involve science, technology, or both and how.

### CAREER DEVELOPMENT/COMMUNITY

As a class, create a collage of interviewees and their careers. Indicate how these careers interact with the community (both positive and negative aspects). Display this collage at the school, the county/city offices, or library.

## ASSESSMENTS

### ACADEMIC CONTENT STANDARD

Evaluate the students on their ability to:

- identify and ask an adult to be interviewed
- write and ask the interview questions appropriately
- record the discussion clearly
- see and communicate the relationship between the career and the community.

### WORKPLACE COMPETENCY

#### THINKING SKILLS: CREATIVE THINKING

Evaluate the students on their ability to:

- infuse the information gained from the interview into a creative presentation
- present the information in a clear and understandable manner
- portray/illustrate the relationship between the career and the community
- identify and show how at least three other career areas involve science, technology, or both
- participate in the collage creation.

# SCIENCE

## Academic Content Standard

6. Students understand that science involves a particular way of knowing and understand common connections among scientific disciplines.

## Workplace Competencies

| GRADES K-4 BENCHMARKS | COMMUNICATION SKILLS: Demonstrates the ability to receive and relay information clearly and effectively | | | | | | | ORGANIZATIONAL SKILLS: Demonstrates skills to effectively and efficiently operate within a workplace | | | | THINKING SKILLS: Demonstrates the ability to use reasoning | | | | | | TECHNOLOGY SKILLS: Demonstrates the ability to work with a variety of technologies | | | | WORKER QUALITIES: Demonstrates the characteristics of an effective worker | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Listening | Speaking | Reading | Writing | Interpreting | Negotiating | Persuading | Planning | Time Management | Using Resources | Systems Thinking | Evaluating | Problem Solving | Decision Making | Creative Thinking | Learning | Analyzing | Mathematics | Computer Literacy | Selects Technology | Applies Technology | Uses Technical Info. | Self Management | Team Member | Responsibility | Flexibility | Leadership | Diversity |
| a. recognizing that when a science experiment is repeated with the same conditions, the experiment generally works the same way | | ● | | ● | | | | | | ● | ● | ● | | | ● | ● | | | | | ● | | | | | | | |
| b. comparing knowledge gained from direct experience to knowledge gained indirectly | ● | | ● | | ● | | | | ● | ● | ● | | | | ● | * | | | | ● | | | | | ● | | | |
| c. identifying observable patterns and changes in their lives and predicting future events based on those patterns | | | ● | | ● | | | | | ● | ● | ● | | | ● | ● | | | | | | ● | | | ● | | | |
| d. describing and comparing the components and interrelationships of a simple system | | ● | ● | ● | | | | | | ● | ● | | | | ● | ● | | | | | | | | ● | | | | |
| e. comparing a model with what it represents | | ● | ● | ● | ● | | | | | ● | ● | | | ● | ● | ● | | | | | | ● | | | | | | |

K-4

GRADE LEVEL

K 1 2 3 4 5 6 7 8 9 10 11 12

**STATE STANDARD**

6. Students understand that science involves a particular way of knowing and understand common connections among scientific disciplines.

**BENCHMARK**

b. comparing knowledge gained from direct experience to knowledge gained indirectly

**WORKPLACE COMPETENCY**

Thinking Skills: Analyzing
identifies bias of information sources, evaluates contradictory information and effectively manages information

## RESOURCE

Science-Ask the Experts! is maintained by the Regional Alliance for Mathematics and Science Education. It has an excellent selection of topics in health, physical education, engineering, medicine, mathematics, earth and space science, and science humor. The website offers archives of questions (and answers) asked in the past, as well as the opportunity to submit additional queries.

ra.terc.edu/alliance/TEMPLATE/regional_networks/cia/science/experts.cfm





## LEARNING ACTIVITIES

### ACADEMIC CONTENT STANDARD

In small groups, students observe their school yard once a month and note changes they observe in plants, animals, weather and what people are wearing. Students chart all information and add to the chart each month. Students create a visual aid that represents the different seasonal pattern in nature. Students also read stories and/or science books about the changing seasons and compare their observations to the descriptions contained in these resources.

### WORKPLACE COMPETENCY

#### THINKING SKILLS: ANALYZING

As a class, identify the elements of analyzing. Students identify any characteristics regarding weather patterns in the resources or in observations. Students identify any contradictory information they obtained about the seasons and analyze possible explanations for these differences.

### CAREER DEVELOPMENT

Invite a zoologist or veterinarian to speak to the class about how seasons change the behavior of animals and how he/she uses the skill of analyzing to find the cause of the behavior. The speaker also could discuss his/her career path.

### COMMUNITY

Students create informational posters on how to dress appropriately for the different seasons and post it throughout their school building.

## ASSESSMENTS

### ACADEMIC CONTENT STANDARD

Evaluate students on their ability to:

- identify seasonal patterns in nature
- create a visual aid that represents the different seasonal patterns in nature
- state the difference between their observations of seasonal patterns and the written descriptions they have read.

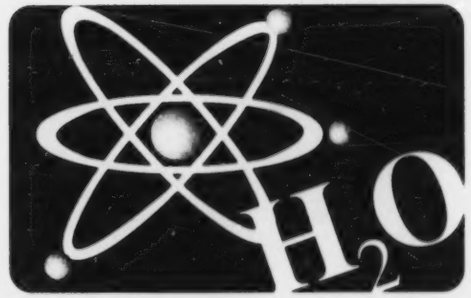
### WORKPLACE COMPETENCY

#### THINKING SKILLS: ANALYZING

Evaluate students on their ability to:

- identify the elements of analyzing
- identify characteristics from the reading and their observations
- see differences between what they see and what they read,
- list reasons for the differences.

# GRADES 5-8




## III. INTEGRATION MATRICES AND CLASSROOM ACTIVITIES

INTEGRATING SCIENCE STANDARDS
WITH WORKPLACE COMPETENCIES

# SCIENCE

## Academic Content Standard

1. Students understand the processes of scientific investigation and design, conduct, and can communicate about and evaluate such investigations.

### Workplace Competencies

| GRADES 5-8 BENCHMARKS | COMMUNICATION SKILLS: Demonstrates the ability to receive and relay information clearly and effectively | | | | | | | ORGANIZATIONAL SKILLS: Demonstrates skills to effectively and efficiently operate within a workplace | | | | | | THINKING SKILLS: Demonstrates the ability to use reasoning | | | | | | TECHNOLOGY SKILLS: Demonstrates the ability to work with a variety of technologies | | | | WORKER QUALITIES: Demonstrates the characteristics of an effective worker | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Listening | Speaking | Reading | Writing | Interpreting | Negotiating | Persuading | Planning | Time Management | Using Resources | Systems Thinking | Evaluating | Problem Solving | Decision Making | Creative Thinking | Learning | Analyzing | Mathematics | Computer Literacy | Selects Technology | Applies Technology | Uses Technical Info. | Self Management | Team Member | Responsibility | Flexibility | Leadership | Diversity |
| a. identifying and evaluating alternative explanations and procedures | | ● | | ● | | | | | | | ● | ● | ● | ● | | ● | | | | | | | | ● | | | | |
| b. using examples to demonstrate that scientific ideas are used to explain previous observations and to predict future events | ● | | ● | ● | | | | | | ● | ● | | ● | | | | | | | | | | | | | | | |
| c. asking questions and stating hypotheses that lead to different types of scientific investigations | ● | | ● | ● | | | | | | | | | ● | ● | | ● | | | | | | | | | | | | |
| d. creating a written plan for an investigation | | | ● | | | | | ● | | | | | ● | | | | | | | | | ● | | | | ● | | |
| e. using appropriate tools, technologies, and measurement units to gather and organize data | | | ● | | | | | ● | ● | | | | ● | | | | | | * | ● | ● | | | | | | | |
| f. interpreting and evaluating data in order to formulate conclusions | | ● | | ● | ● | | | | | | ● | | ● | | | ● | | | | | | | | | | | | |
| g. communicating results of their investigations in appropriate ways | | ● | ● | ● | | | | | | | ● | | | | ● | | | ● | | ● | | | | ● | | | | |

GRADE LEVEL **5-8**

K 1 2 3 4 5 6 7 8 9 10 11 12

**STATE STANDARD**

1. Students understand the processes of scientific investigation and design, conduct, communicate about and evaluate such investigations.

**BENCHMARK**

e. using appropriate tools, technologies, and measurement units to gather and organize data

**WORKPLACE COMPETENCY**

Technology Skills: Selects Technology chooses appropriate procedures, tools or equipment

## QUOTATION

"I like science for three reasons. One, science takes you places you've never been before. Two, you learn about the human body. Three, you learn about the wildest things on earth."

- Tony Barton, 6th Grader





## LEARNING ACTIVITIES

### ACADEMIC CONTENT STANDARD

Students, in groups of 2-3, investigate the use of trail pheromones by termites, using Eastern subterranean termites. Students draw a line on filter paper and observe the termites to see if it follows the pen line or not.

After experimenting with different colors, brands and styles of pens, students propose a hypothesis for the behavior of the termites and then use the scientific method to test their hypothesis. This activity creates more questions than it answers, so students can revise their hypothesis and retest many times. Students need to continually record their observations and create a data table showing termite responses. Students also need to write each new question that occurs to them as they are engaged in this activity

### WORKPLACE COMPETENCY

#### TECHNOLOGY SKILLS: SELECTS TECHNOLOGY

Students create a table, chart or graph and brainstorm strategies to display their hypothesis, tests and findings. Students may choose from all available tools to do so (e.g. a computer program, graph paper, etc.). Career information discovered is shared. The internet may be used to gather this information as well.

### CAREER DEVELOPMENT

- Invite a representative from a pest control office to speak to the class on the possible damage done by termites and the technological tools used in this profession.
- Invite an expert on termites to discuss chemical communication in termite societies.

### COMMUNITY

Students create a brochure about termites and what to look for to find termite damage.

## ASSESSMENTS

### ACADEMIC CONTENT STANDARD

Evaluate students on their ability to:

- follow the directions of the experiment
- make observations
- record their observations accurately
- create valid questions to be addressed
- create a hypothesis based on the findings.

### WORKPLACE COMPETENCY

#### TECHNOLOGY SKILLS: SELECTS TECHNOLOGY

Evaluate students on their ability to:

- choose an appropriate type of technology to create their report
- create a report (pictorial, written, etc) to portray their findings.

# SCIENCE

## Academic Content Standard

2. Physical Science: Students know and understand common properties, forms and changes in matter and energy.

2.2 Students know that energy appears in different forms, and can move (be transferred) and change (be transformed).

## Workplace Competencies

| GRADES 5-8 BENCHMARKS | COMMUNICATION SKILLS: Demonstrates the ability to receive and relay information clearly and effectively | | | | | | | ORGANIZATIONAL SKILLS: Demonstrates skills to effectively and efficiently operate within a workplace | | | | | | | THINKING SKILLS: Demonstrates the ability to use reasoning | | | | | | | TECHNOLOGY SKILLS: Demonstrates the ability to work with a variety of technologies | | | | WORKER QUALITIES: Demonstrates the characteristics of an effective worker | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Listening | Speaking | Reading | Writing | Interpreting | Negotiating | Persuading | Planning | Time Management | Using Resources | Systems Thinking | Evaluating | Problem Solving | Decision Making | Creative Thinking | Learning | Analyzing | Mathematics | Computer Literacy | Selects Technology | Applies Technology | Uses Technical Info. | Self Management | Team Member | Responsibility | Flexibility | Leadership | Diversity |
| a. measuring quantities associated with energy forms | | ● | | | | | | | | | | ● | | | | ● | ● | | | ● | | | | | | | | |
| b. describing qualitative and quantitative relationships, using data and observations and graphs associated with energy transfer or energy transformation | ● | ● | ● | ● | | | * | | | ● | | | | | | ● | ● | | | | | | | | | | | |

GRADE LEVEL **5-8**

K 1 2 3 4 5 6 7 8 9 10 11 12

**STATE STANDARD**

2. Physical Science: Students know and understand common properties, forms, and changes in matter and energy.
   2.2 Students know that energy appears in different forms, and can move (be transferred) and change (be transformed).

**BENCHMARK**

b. describing qualitative and quantitative relationships, using data and observations and graphs, associated with energy transfer or energy transformation

**WORKPLACE COMPETENCY**

Organizational Skills: Planning
devises and outlines a process to achieve a goal and timeline

## QUOTATIONS

"The Science of designing roller coasters is basic physics, potential energy, potential energy converted to kinetic energy, speeds, stresses on the ride and reactions to forces. Engineers of rollercoasters know their math, physics and G-loads. Designing rollercoasters is a fun business, that challenges technical skills, something only imagined in your dreams and the sky's the limit - maybe beyond the sky, who knows."

- Dal Freeman
Director of Engineering
Arrow Dynamics Inc.

- Ronald V. Toomer
Designer of Viper Rollercoaster
President, Arrow Dynamics Inc.

- Ed Dampler
Technical Manager
Six Flags Magic Mountain





## LEARNING ACTIVITIES

### ACADEMIC CONTENT STANDARD

Students will have completed a unit on physics and discussed the definition and differences between quantitative and qualitative data. In small groups, students design a roller coaster or slow flying paper airplane using their knowledge of energy and motion.

After designing and testing their planes or roller coasters, students measure the distance their creations traveled and time in seconds it took to travel that distance. The students then calculate the speed using the formula, speed = distance divided by time. Students create a data table showing all measurements and calculations.

### WORKPLACE COMPETENCY

#### ORGANIZATIONAL SKILLS: PLANNING

The class discusses the steps of planning and brainstorms many ways the skill is used. Student groups develop a written, step-by-step plan of how they are going to develop and design the project. Then students create a detailed blueprint of the actual rollercoaster/plane. The blueprint must include measurements, angles, formulas, speeds, etc.

### CAREER DEVELOPMENT

- Invite an aeronautical engineer to discuss airplane design.
- Invite guest speakers such as architects and engineers to discuss the planning involved in these types of professions.

### COMMUNITY

- Students visit an elementary classroom to share the above activities and explain speed to the younger students.
- Students take a study trip to a local amusement park to collect data and information on various rides in the park.

## ASSESSMENTS

### ACADEMIC CONTENT STANDARD

Evaluate students on their ability to:
- identify quantitative and qualitative data
- collect information and use the data effectively
- create a realistic and well thought-out design.

Student groups also evaluate other groups on:
- the creativity and functionality of their design.

### WORKPLACE COMPETENCY

#### ORGANIZATIONAL SKILLS: PLANNING

Students will be evaluated on their ability to:
- identify the steps used in planning
- work well as a member of a team
- use resources and time effectively
- identify other tasks and environments that require planning.

### EXTENSION

A great collection of roller coaster pictures, coaster-related events and news, and answers to frequently asked questions for roller coaster buffs can be found at:

http://sunsite.unc.edu/darlene/coaster/coaster.html

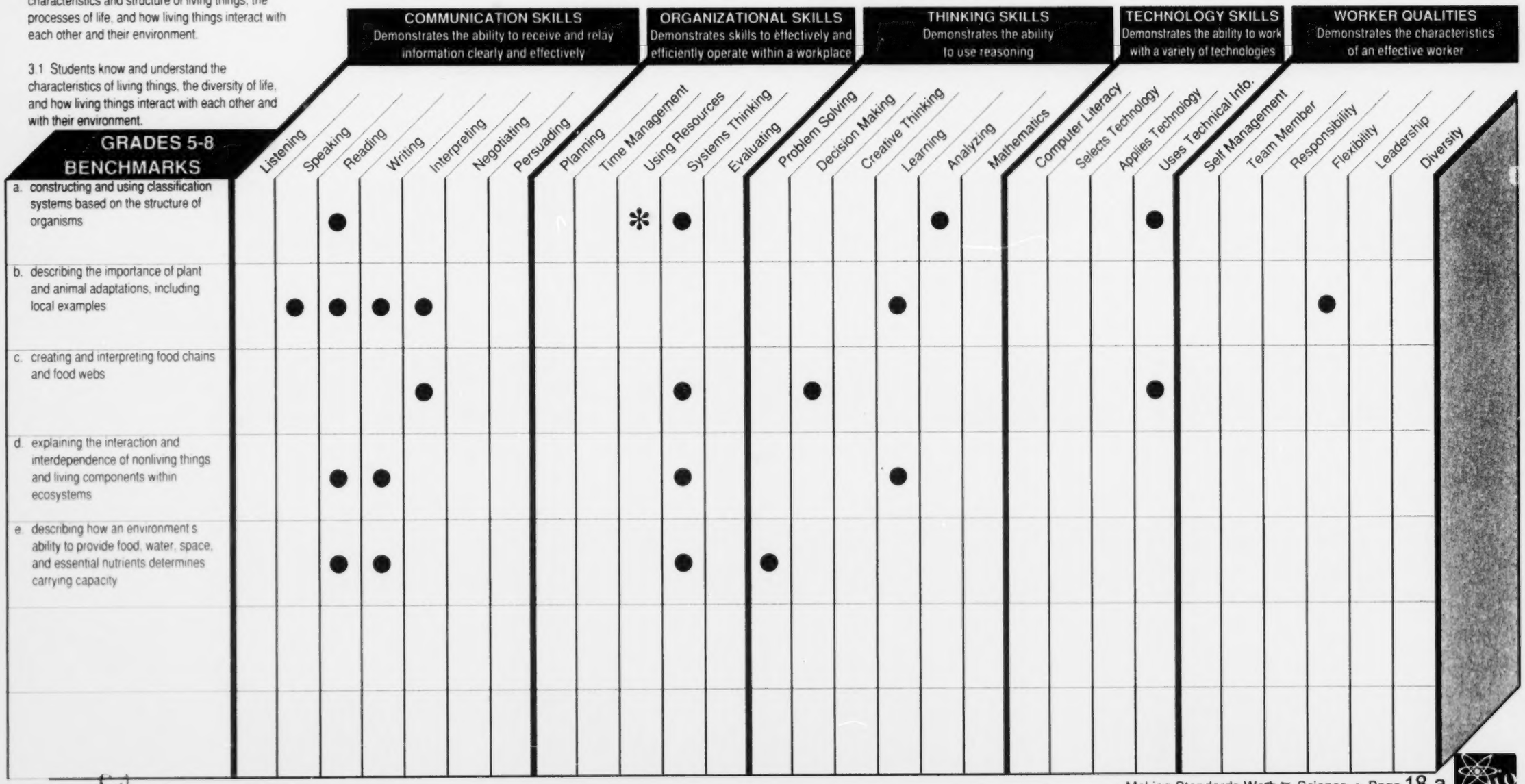
# SCIENCE

## Academic Content Standard

3. Life Science: Students know and understand the characteristics and structure of living things, the processes of life, and how living things interact with each other and their environment.

3.1 Students know and understand the characteristics of living things, the diversity of life, and how living things interact with each other and with their environment.

## Workplace Competencies



GRADE LEVEL **5-8**

K 1 2 3 4 5 6 7 8 9 10 11 12

**STATE STANDARD**

3. Life Science: Students know and understand the characteristics and structure of living things, the processes of life, and how living things interact with each other and their environment.
   3.1 Students know and understand the characteristics of living things, the diversity of life, and how living things interact with each other and with their environment.

**BENCHMARK**

a. constructing and using classification systems based on the structure of organisms

**WORKPLACE COMPETENCY**

Organizational Skills: Using Resources identifies, organizes, plans and allocates resources

## QUOTATION

"I like Science a lot because Science is really fun, especially when we got to dissection. It's fun because you learn new and weird things and you get to try experiments."

- Kelley McCourt, 6th Grader



# SCIENCE

## LEARNING ACTIVITIES

### ACADEMIC CONTENT STANDARD

Students research the medicinal value of trees and plants in the rainforest using traditional and online research sources. Students identify as many medicines that originate in the rainforest as they can and write an essay or create a visual presentation describing their findings and classification of each plant.

Students estimate the number of rainforest trees cut down each year and the amount of carbon dioxide that remains in the atmosphere as a result of deforestation. Students then answer the question: What effect does this have on our world? (plants, humans, wildlife, etc.)

### WORKPLACE COMPETENCY

#### ORGANIZATIONAL SKILLS: USING RESOURCES

Students define the concept of organizing and using resources. Students then name and use at least five different research sources (Internet, encyclopedias, people, etc.) and evaluate the advantages and disadvantages of the various sources. Student identify at least three jobs that would utilize the research sources.

### CAREER DEVELOPMENT

Invite a conservationist to help the students explore the following questions:

- What resources does the U.S. use to protect its wildlife?
- How does the U.S. policy differ from the policies in central American countries and why?
- What major problems do conservationists from the U.S. and other countries confront in their work?
- What kind of education and training is needed to pursue a career in the field?

### COMMUNITY

Students create an "endangered plant species" booklet that includes practical solutions to this global problem.

## ASSESSMENTS

### ACADEMIC CONTENT STANDARD

Evaluate the students on their ability to:

- demonstrate their understanding of the characteristics of plants and trees and how they interact with the environment
- accurately and thoroughly list the plants using a classification system
- justify their estimations of trees cut down and remaining carbon dioxide
- explain the effects of deforestation on our world using a well-organized presentation.

### WORKPLACE COMPETENCY

#### ORGANIZATIONAL SKILLS: USING RESOURCES

Evaluate the students on their ability to:

- give examples and uses of 5 different resources
- list the resources used to locate the information
- list resources which were helpful, which were not, and why.

### EXTENSION

- Students identify products, manufactured from tropical woods such as teak, rosewood or mahogany and illustrate these in a logo or poster which explains the consequences of their use.
- Identify reasons to discourage the purchase of tropical pets that come from the rainforest such as snakes, fish, and exotic birds. Conduct a debate on the subject.
- Students create a poster for the local library depicting local plants and their uses.

# SCIENCE

## Academic Content Standard

4. Earth and Space Science: Students know and understand the processes and interactions of Earth s systems and the structure and dynamics of Earth and other objects in space.

4.4 Students know the structure of the solar system, composition and interactions of objects in the universe, and how space is explored.

## Workplace Competencies

| GRADES 5-8 BENCHMARKS | COMMUNICATION SKILLS: Demonstrates the ability to receive and relay information clearly and effectively | | | | | | | ORGANIZATIONAL SKILLS: Demonstrates skills to effectively and efficiently operate within a workplace | | | | | | | THINKING SKILLS: Demonstrates the ability to use reasoning | | | | | | | TECHNOLOGY SKILLS: Demonstrates the ability to work with a variety of technologies | | | | WORKER QUALITIES: Demonstrates the characteristics of an effective worker | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Listening | Speaking | Reading | Writing | Interpreting | Negotiating | Persuading | Planning | Time Management | Using Resources | Systems Thinking | Evaluating | Problem Solving | Decision Making | Creative Thinking | Learning | Analyzing | Mathematics | Computer Literacy | Selects Technology | Applies Technology | Uses Technical Info. | Self Management | Team Member | Responsibility | Flexibility | Leadership | Diversity |
| a. describing the basic components, composition, size, and theories of origin of the solar system | ● | ● | ● | | | | | | | ● | | | | | | ● | | | | | | | | | | | | |
| b. explaining the effects of relative motion and positions of the Sun, Earth, and Moon | ● | ● | ● | | | | | | | ● | | | | | | ● | | | | | ● | | | | | | | |
| c. comparing Earth to other planets | | | ● | | | | | | | ● | | | | | ● | ● | * | | | | ● | | | | | | | |
| d. identifying technology needed to explore space | | | ● | | | | | | | ● | | ● | | | | | | | ● | | ● | | | | | | | |

GRADE LEVEL **5-8**

K 1 2 3 4 5 6 7 8 9 10 11 12

**STATE STANDARD**

4. Earth and Space Science: Students know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.
   4.4 Students know the structure of the solar system, composition and interactions of objects in the universe, and how space is explored.

**BENCHMARK**

c. comparing Earth to other planets

**WORKPLACE COMPETENCY**

Thinking Skills: Mathematics
performs basic computations and solves practical problems by applying appropriate mathematical techniques

## RESOURCE

Will and Company is a not-for-profit, multi-lingual, multi-cultural theatre based at the Los Angeles Theatre Center in downtown Los Angeles. The company performs work that addresses the issues of multi-culturalism in America today, the condition of the environment we live in, and the needs of our classrooms. Will & Company has created a series of plays and guides designed to help young audiences grasp the concepts and history of science in a hands-on interactive medium. The series includes plays on Biology, Chemistry, Mathematics, and Modern Physics.

Will & Company
514 South Spring Street
Los Angeles, CA 90013
213/485-1631
213/489-3481 (fax)
www.willandcompany.com





## LEARNING ACTIVITIES

### ACADEMIC CONTENT STANDARD

Students create a data table comparing Earth to the other eight planets. The following characteristics should be included in the data table:

- distance from the Sun
- temperature (day and night)
- size
- composition
- revolution period
- number of moons
- any other characteristics (student's choice)

Students then create a graph for each planet.

### WORKPLACE COMPETENCY

#### THINKING SKILLS: MATHEMATICS

The mathematical concepts used in this lesson are identified and discussed. Working in small groups and using information from their data table, students create a scale model of either the relative size of planets or the distance from the sun of each planet.

### CAREER DEVELOPMENT

Communicate via the Internet with an astronomer or astrophysicist about how mathematics is used to understand the solar system. Career development information can also be gathered.

Visit a planetarium and invite a planetarium operator to give a presentation in regards to their career.

### COMMUNITY

Groups of students share their models with younger students by showing and identifying the basic components of the solar system.

## ASSESSMENTS

### ACADEMIC CONTENT STANDARD

Evaluate the students on their ability to:

- demonstrate their understanding of the structure, composition and interactions of the solar system
- compare the differences between Earth and the other planets
- research the information for their data table.

### WORKPLACE COMPETENCY

#### THINKING SKILLS: MATHEMATICS

Evaluate students on their ability to:

- accurately complete their data table and graphs
- use correct computations in creating their scale models
- complete their model accurately.

# SCIENCE

## Academic Content Standard

5. Students know and understand interrelationships among science, technology, and human activity and how they can affect the world.

## Workplace Competencies

| GRADES 5-8 BENCHMARKS | COMMUNICATION SKILLS: Demonstrates the ability to receive and relay information clearly and effectively | | | | | | | ORGANIZATIONAL SKILLS: Demonstrates skills to effectively and efficiently operate within a workplace | | | | | THINKING SKILLS: Demonstrates the ability to use reasoning | | | | | | | TECHNOLOGY SKILLS: Demonstrates the ability to work with a variety of technologies | | | | WORKER QUALITIES: Demonstrates the characteristics of an effective worker | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Listening | Speaking | Reading | Writing | Interpreting | Negotiating | Persuading | Planning | Time Management | Using Resources | Systems Thinking | Evaluating | Problem Solving | Decision Making | Creative Thinking | Learning | Analyzing | Mathematics | Computer Literacy | Selects Technology | Applies Technology | Uses Technical Info. | Self Management | Team Member | Responsibility | Flexibility | Leadership | Diversity |
| a. investigating and describing the extent of human uses of renewable and non-renewable resources | ● | ● | ● | | | | | | ● | ● | | ● | | | ● | | | | | ● | | | | | | | ● | |
| b. describing advantages and disadvantages that might accompany the introduction of a new technology | ● | ● | ● | | | | | | | ● | | | ● | | | ● | | | | | ● | | | | | | | |
| c. describing how the use of technology can help solve an individual or community problem | ● | ● | ● | | | | | | ● | ● | ● | ● | | | | | | | ● | ● | * | | | ● | ● | | | | |
| d. describing how people use science and technology in their professions | ● | ● | ● | | | | | | | | ● | | | ● | ● | ● | | | | | ● | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | 73 | | |

72

GRADE LEVEL **5-8**

K 1 2 3 4 5 6 7 8 9 10 11 12

**STATE STANDARD**

5. Students know and understand interrelationships among science, technology, and human activity and how they can affect the world.

**BENCHMARK**

c. describing how the use of technology can help solve an individual or community problem

**WORKPLACE COMPETENCY**

Technology Skills: Uses Technical Information interprets and uses data generated from a variety of technological devices

## QUOTATION

"I think Science is interesting and fun. The reason why is I think Science teaches about technology and other fun things!"

- Debbie Trujillo, 6th Grader

74

# SCIENCE

## LEARNING ACTIVITIES

### ACADEMIC CONTENT STANDARD

- Students investigate how wastewater is cleaned. Students then experiment with a variety of methods to clean the dirty water and report to the class on the methods used. Students research community wastewater treatment and technologies used.
- Write and illustrate a story "The Journey of a Drop" that follows a drop of water from the time it goes down the bathtub drain until it enters a river.

### WORKPLACE COMPETENCY

#### TECHNOLOGY SKILLS: USES TECHNICAL INFORMATION

Students compile a description of the different technologies used in water treatment, including how they work, what they do, and alternative methods of doing the same thing.

### CAREER DEVELOPMENT

Each student contributes to a class technology list by asking three adults to tell them the technology they use in their jobs.

### COMMUNITY

- Invite a classroom speaker to bring the "tools of their trade" in a paper sack. As they bring out tools one at a time, students use 20 questions to guess his/her career.
- Conduct a study trip to a wastewater treatment plant focusing on the technology used.
- Students design a poster on the theme "Technology Solves Many Problems".

## ASSESSMENTS

### ACADEMIC CONTENT STANDARD

Evaluate students on their ability to:

- accurately outline the process of water treatment
- describe the technology used in water treatment
- describe how the population is affected by the technology and process of water treatment.

### WORKPLACE COMPETENCY

#### TECHNOLOGY SKILLS: USES TECHNICAL INFORMATION

Evaluate students on their ability:

- identify data sources for technical information regarding technology used in water treatment
- compare and contrast various water treatment technologies
- make and defend conclusions about the effectiveness of various water treatment technologies.

75

# SCIENCE

## Academic Content Standard

6. Students understand that science involves a particular way of knowing and understand common connections among scientific disciplines.

## Workplace Competencies

| GRADES 5-8 BENCHMARKS | COMMUNICATION SKILLS: Demonstrates the ability to receive and relay information clearly and effectively | | | | | | | ORGANIZATIONAL SKILLS: Demonstrates skills to effectively and efficiently operate within a workplace | | | | | THINKING SKILLS: Demonstrates the ability to use reasoning | | | | | | | TECHNOLOGY SKILLS: Demonstrates the ability to work with a variety of technologies | | | | WORKER QUALITIES: Demonstrates the characteristics of an effective worker | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Listening | Speaking | Reading | Writing | Interpreting | Negotiating | Persuading | Planning | Time Management | Using Resources | Systems Thinking | Evaluating | Problem Solving | Decision Making | Creative Thinking | Learning | Analyzing | Mathematics | Computer Literacy | Selects Technology | Applies Technology | Uses Technical Info. | Self Management | Team Member | Responsibility | Flexibility | Leadership | Diversity |
| a. explaining why a controlled experiment must have comparable results when repeated | | ● | ● | ● | | | | | | ● | | | ● | | | ● | ● | | | | | | | | | | | |
| b. giving examples of how scientific knowledge changes as new knowledge is acquired and previous ideas are modified | | | ● | ● | | | | | | ● | | | | ● | | ● | ● | | | | | | | | | | | |
| c. describing contributions to the advancement of science made by people in different cultures and at different times in history | | * | ● | ● | | | | | | ● | | | | | | | | | | | ● | | | | | | ● | |
| d. identifying, comparing, and predicting variables and conditions related to change | | | | | | | | | | ● | | | ● | ● | ● | ● | ● | ● | | | ● | | | | | | | |
| e. identifying and illustrating natural cycles within systems | | | ● | ● | | | | | | ● | | | ● | | ● | ● | ● | ● | | ● | | | | | | | | |
| f. using a model to predict change | | | | | ● | | | | | ● | | | ● | | | ● | ● | | | | | | | | | | | |

GRADE LEVEL **5-8**

K 1 2 3 4 5 6 7 8 9 10 11 12

**STATE STANDARD**

6. Students understand that science involves a particular way of knowing and understand common connections among scientific disciplines.

**BENCHMARK**

c. describing contributions to the advancement of science made by people in different cultures and at different times in history

**WORKPLACE COMPETENCY**

Communication Skills: Speaking
clearly organizes and effectively presents ideas orally

## QUOTATION

"The trend we're seeing in the workforce is skill levels are falling every year. We have got to start working with people at a much younger age to prepare them for work."

- Paul Herrick, Human Resources
Nielsens Construction
Serving the Western United States



# SCIENCE

## LEARNING ACTIVITIES

### ACADEMIC CONTENT STANDARD

From a list of events or scientists throughout history (i.e., Mayan astronomers, the moon walk, Madame Curie, Leonardo DiVinci, Galileo, and Sir Isaac Newton), students choose a topic for an in-depth research presentation. Students prepare a paper or other written presentation (interview, dialogue, etc.) that highlights the common connections between scientific disciplines, the advancements made, and the impact of the scientific advancements today.

### WORKPLACE COMPETENCY

#### COMMUNICATION SKILLS: SPEAKING

Students identify many different ways of presenting information and the most effective techniques for doing so. After researching and completing their written presentation, students present their findings and opinions orally to the class using some of the effective presentation techniques identified above. Students decide on the format to be used (i.e., formal speech, interview, debate, etc.).

### CAREER DEVELOPMENT

Connect with a research facility in the community or through the internet to explore how science discoveries of the past effect their work today. Career information can also be gathered and shared through this interaction.

### COMMUNITY

Students combine their work to create a presentation or play about scientific advancements and perform it for elementary school students, senior centers or other interested audiences.

## ASSESSMENTS

### ACADEMIC CONTENT STANDARD

Evaluate students on their ability to:

- demonstrate their understanding of common connections between scientific disciplines
- accurately identify the advancements that scientific concepts have made and how these advancements impact our lives.

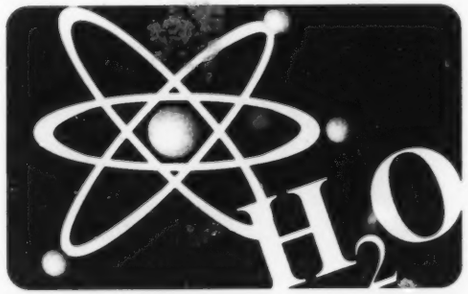
### WORKPLACE COMPETENCY

#### COMMUNICATION SKILLS: SPEAKING

Evaluate the students on their ability to:

- follow the research process (i.e., note taking, resource location, rough draft, final draft)
- organize information
- speak clearly
- use eye contact
- use aids such as visual, etc.

# GRADES 9-12




## III. INTEGRATION MATRICES AND CLASSROOM ACTIVITIES

INTEGRATING SCIENCE STANDARDS
WITH WORKPLACE COMPETENCIES

# SCIENCE

## Academic Content Standard

1. Students understand the processes of scientific investigation and design, conduct, and can communicate about and evaluate such investigations.

## Workplace Competencies

| GRADES 9-12 BENCHMARKS | COMMUNICATION SKILLS: Demonstrates the ability to receive and relay information clearly and effectively | | | | | | | ORGANIZATIONAL SKILLS: Demonstrates skills to effectively and efficiently operate within a workplace | | | | | | THINKING SKILLS: Demonstrates the ability to use reasoning | | | | | | TECHNOLOGY SKILLS: Demonstrates the ability to work with a variety of technologies | | | WORKER QUALITIES: Demonstrates the characteristics of an effective worker | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Listening | Speaking | Reading | Writing | Interpreting | Negotiating | Persuading | Planning | Time Management | Using Resources | Systems Thinking | Evaluating | Problem Solving | Decision Making | Creative Thinking | Learning | Analyzing | Mathematics | Computer Literacy | Selects Technology | Applies Technology | Uses Technical Info. | Self Management | Team Member | Responsibility | Flexibility | Leadership | Diversity |
| a. asking questions and stating hypotheses, using prior scientific knowledge to help guide their development | ● | ● | | | | | | | | | | | | ● | | ● | | | | | | | | | | | | |
| b. creating and defending a written plan of action for a scientific investigation | | | | ● | * | | ● | ● | ● | ● | | | ● | | ● | ● | | | | | | | ● | | ● | | | |
| c. selecting and using appropriate technologies to gather, process, and analyze data and to report information related to an investigation | | ● | ● | ● | ● | | | ● | | ● | | | | ● | | ● | | | | ● | ● | | | | | ● | | |
| d. identifying major sources of error or uncertainty within an investigation | | | ● | | ● | | | | | | | ● | ● | | | ● | | | | | | | ● | | ● | | | |
| e. constructing and revising scientific explanations and models, using evidence, logic, and experiments that include identifying and controlling variables | | | ● | | ● | | | ● | ● | ● | ● | ● | ● | | | ● | | | | | ● | | ● | | ● | | | |
| f. communicating and evaluating scientific thinking that leads to particular conclusions | | ● | ● | ● | ● | | | | | | ● | ● | ● | | ● | ● | | ● | | | | | | | | | | |
| g. recognizing and analyzing alternative explanations and models | | | ● | | | | | | | | | | ● | ● | ● | ● | | | | | ● | | | | | ● | | |

GRADE LEVEL

K 1 2 3 4 5 6 7 8 9 10 11 12

9-12

**STATE STANDARD**

1. Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.

**BENCHMARK**

b. creating and defending a written plan of action for a scientific investigation

**WORKPLACE COMPETENCY**

Communication Skills: Interpreting delineates and analyzes oral and written information and synthesizes information into a conclusion

## QUOTATION

"I have never been interested in Science until this year, when I actually got to do "hands on work". Now I am considering a career in the field."

- Gwen, High School Student



# SCIENCE

## LEARNING ACTIVITIES

### ACADEMIC CONTENT STANDARD

Students complete their own investigation of a crime scene to identify "Who Done It!" Students receive notes from interviews of the witnesses to the crime and of the suspects, as well as a list of evidence collected. They also have access to the actual (physical) crime scenes where they can collect additional evidence and investigate their theories.

Students participate in laboratory experiments in fingerprinting (chemistry), chemical analysis of residues found at the crime scene (chemistry), ballistics (physics), and alternate light source (chemistry and physics).

### WORKPLACE COMPETENCY

#### COMMUNICATION SKILLS: INTERPRETING

The concept of interpreting is discussed. The class brainstorms strategies that are used to interpret information. Students then interpret this information and apply it in their investigation of the crime.

### CAREER DEVELOPMENT

Students discuss the types of careers that are associated with this activity. Examples include: police officer, biologist, geneticist, chemist, and coroner. Students invite local experts in these fields to come to their classroom for a panel discussion regarding their roles in crime investigation and career information. (Examples: Colorado Bureau of Investigation, chemist from local lab, DNA expert, etc.).

### COMMUNITY

Students investigate the media's role in crime investigation and talk to school police about crime investigation at school.

## ASSESSMENTS

### ACADEMIC CONTENT STANDARD

Evaluate students on their ability to:

- demonstrate an understanding of the scientific processes involved in an investigation
- defend their conclusion about who committed the crime and how it was committed.

### WORKPLACE COMPETENCY

#### COMMUNICATION SKILLS: INTERPRETING

Evaluate students on their ability to:

- collect accurate information
- interpret data derived from experiments accurately
- apply data to reach a conclusion
- defend their conclusion.

### EXTENSIONS

Students can use the Internet and other media sources (i.e., newspapers, television, radio) to find out about noteworthy criminal investigations in the past or present.

# SCIENCE

## Academic Content Standard

2. Physical Science: Students know and understand common properties, forms and changes in matter and energy.

2.2 Students know that energy appears in different forms, and can move (be transferred) and change (be transformed).

## Workplace Competencies

| GRADES 9-12 BENCHMARKS | COMMUNICATION SKILLS: Demonstrates the ability to receive and relay information clearly and effectively | | | | | | | ORGANIZATIONAL SKILLS: Demonstrates skills to effectively and efficiently operate within a workplace | | | | | | | THINKING SKILLS: Demonstrates the ability to use reasoning | | | | | | | TECHNOLOGY SKILLS: Demonstrates the ability to work with a variety of technologies | | | | | WORKER QUALITIES: Demonstrates the characteristics of an effective worker | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Listening | Speaking | Reading | Writing | Interpreting | Negotiating | Persuading | Planning | Time Management | Using Resources | Systems Thinking | Evaluating | Problem Solving | Decision Making | Creative Thinking | Learning | Analyzing | Mathematics | Computer Literacy | Selects Technology | Applies Technology | Uses Technical Info. | Self Management | Team Member | Responsibility | Flexibility | Leadership | Diversity |
| a. identifying, measuring, calculating, and analyzing quantitative relationships involved with energy forms | | ● | ● | ● | | | ● | | | ● | ● | ● | | | | ● | | | | | | ● | * | | | | | |
| b. identifying, measuring, calculating, and analyzing qualitative and quantitative relationships associated with energy transfer or energy transformation | | ● | ● | ● | | | ● | | | ● | ● | ● | | | | ● | ● | | | | | ● | | | | | | |

86

87

GRADE LEVEL

K 1 2 3 4 5 6 7 8 9 10 11 12

9-12

**STATE STANDARD**

2. Physical Science: Students know and understand common properties, forms, and changes in matter and energy.
   2.2 Students know that energy appears in different forms, and can move (be transferred) and change (be transformed).

**BENCHMARK**

a. identifying, measuring, calculating, and analyzing quantitative relationships involved with energy forms

**WORKPLACE COMPETENCY**

Worker Qualities: Team Member
contributes to group effort through cooperation and consensus

## RESOURCE

TeacherLINK is provided as a service to public educators and students. It contains links to wonderful educational resources, lessons plans and classroom activities, NASA educational materials, and much more.

Nathan Smith or Steve Soulier
Educational Resources and Technology Center
NASA Educator Resource Center
2845 Old Main Hill - Utah State University
Logan, UT 84322-2845
435/797-3377 or 435/797-2653 (respectively)
www.teacherlink.usu.edu





## LEARNING ACTIVITIES

### ACADEMIC CONTENT STANDARD

Student teams design a car using a mouse trap as the energy source. The car must fit design constraints and achieve minimum standards set by the instructor (distance traveled, etc). Students research and test this type of energy source and compare it to other types of sources (solar, rubber band, etc.)

### WORKPLACE COMPETENCY

#### WORKER QUALITIES: TEAM MEMBER

The class explores the ""do's and dont's"" of working as a team member. Students work in teams to brainstorm ideas for the design and then discuss pros and cons of various design features and any modifications needed. Students justify their ideas for design and modification and come to agreement as to which design to use.

### CAREER DEVELOPMENT

Students search the Internet for information on race car design from Ford, Chevrolet, and/or other organizations. Students extend their search to include information about careers in this industry (i.e., chemist for Ford who develops sun resistant paint; mechanic that works with the on-board computers of domestic cars; salesman that must explain the new fuel injector on the car he plans to sell to a concerned customer).

### COMMUNITY

Students investigate the advantages and disadvantages of cars, buses, and light rail in terms of energy consumption.

## ASSESSMENTS

### ACADEMIC CONTENT STANDARD

Evaluate students on their ability to:

- understand the principles of energy by specifically describing energy and its different forms
- design a car that meets the design constraints
- identify, measure, calculate and analyze the quantitative relationship of energy and their car (distance traveled, etc.),
- modify design
- describe at least two other energy sources and make comparisons.

### WORKPLACE COMPETENCY

#### WORKER QUALITIES: TEAM MEMBER

Evaluate students on their ability to:

- contribute to the group process (offers ideas and problem solves)
- serve as an integral part of the group by collaborating and working through conflicts
- develop strategies for accomplishing team objectives.

### EXTENSIONS

Students can participate in National Renewable Lab solar car races. Using distance and time, students determine the speed of their car. Using speed and time, students determine the acceleration of their cars. Students use the computer to graph the collected data.

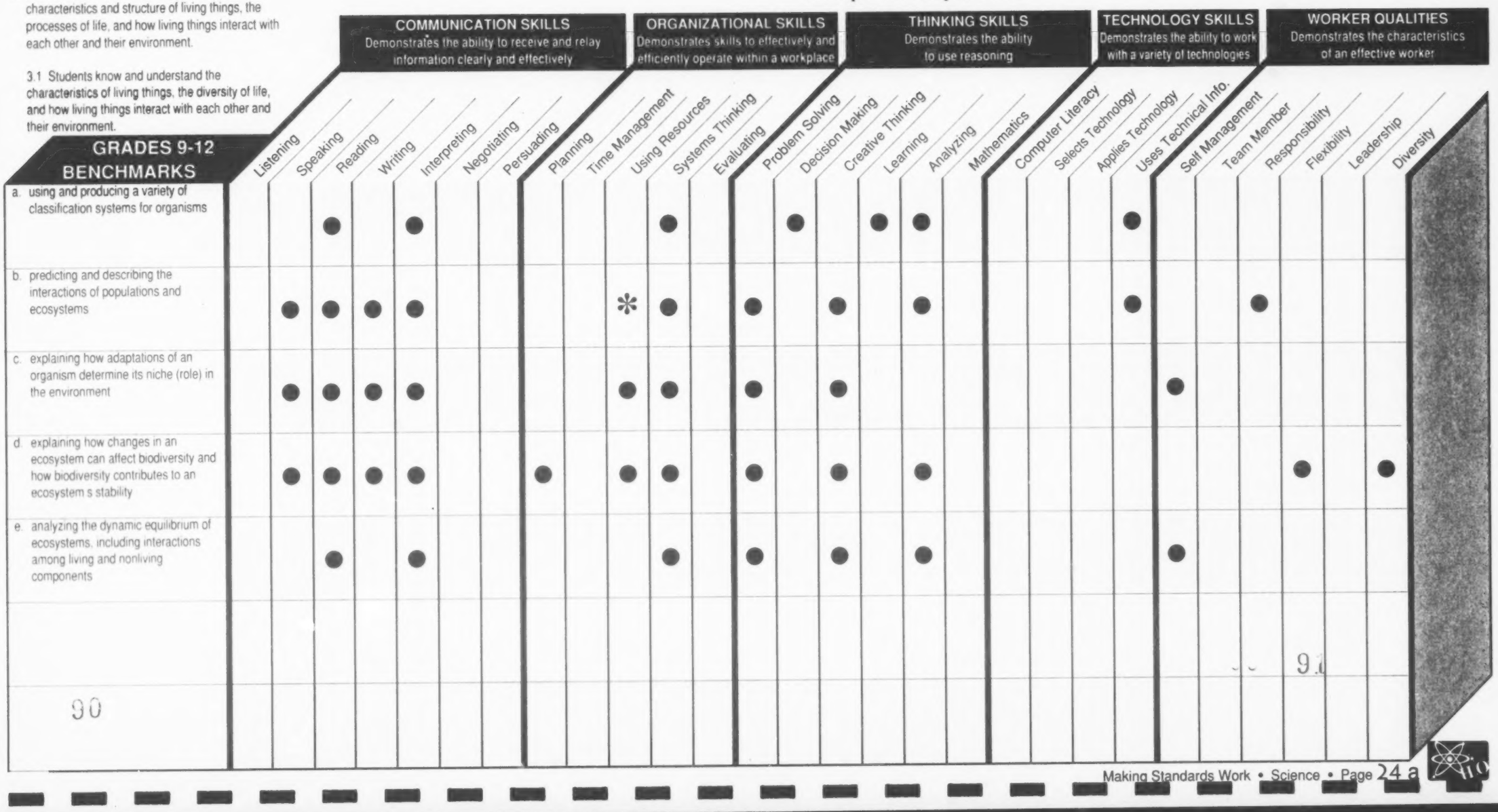
# SCIENCE

## Academic Content Standard

3. Life Science: Students know and understand the characteristics and structure of living things, the processes of life, and how living things interact with each other and their environment.

3.1 Students know and understand the characteristics of living things, the diversity of life, and how living things interact with each other and their environment.

## Workplace Competencies



GRADE LEVEL **9-12**

K 1 2 3 4 5 6 7 8 9 10 11 12

**STATE STANDARD**

3. Life Science: Students know and understand the characteristics and structure of living things, the processes of life, and how living things interact with each other and their environment.
   3.1 Students know and understand the characteristics of living things, the diversity of life, and how living things interact with each other and with their environment.

**BENCHMARK**

b. predicting and describing the interactions of populations and ecosystems

**WORKPLACE COMPETENCY**

Organizational Skills: Using Resources
identifies, organizes, plans and allocates resources

## RESOURCE

The American Geophysical Union (AGU) is a nonprofit organization established in 1919 by the National Research Council. AGU has supplied an organizational framework within which geophysicists have created programs and products to advance their science. In 1972, AGU was incorporated in the District of Columbia and membership was opened to scientists and students worldwide. AGU is now an active community of over 35,000 scientists from 115 countries.

American Geophysical Union
2000 Florida Avenue NW
Washington, DC 20009-1277
800/966-2481 (North America only)
202/328-0566 (fax)
service@kosmos.agu.org (email)
http://www.agu.org



# SCIENCE

## LEARNING ACTIVITIES

### ACADEMIC CONTENT STANDARD

As a class, brainstorm a list of wild animals that live in Colorado. Each student picks an animal from the list to research. Students research the natural habitat and identify the type of environment that the animal needs for survival. Students identify any changes to the animals natural habitat and how the animal has adapted to those changes. Students explore how the rate of environmental change may exceed the capacity of organisms to respond to change, leading to the extinction of species.

### WORKPLACE COMPETENCY

#### ORGANIZATIONAL SKILLS: USING RESOURCES

Students identify resources to support their research and use a variety of resources including a personal interview with an expert in the field.

### CAREER DEVELOPMENT

As students conduct their interviews of experts, they will also explore the education and training requirements and job responsibilities of the experts field.

### COMMUNITY

- As a class, present research findings to the wildlife or parks and recreation division in the community and brainstorm ideas for creating animal and people-friendly areas.
- Get involved in a service-learning project such as river bank restoration, wetlands preservation, etc.

## ASSESSMENTS

### ACADEMIC CONTENT STANDARD

Evaluate students on their ability to:

- conduct research effectively and efficiently
- present research conclusions in an appropriate format and in a well-organized manner
- analyze the impact of changes in the environment on the animal
- pose and defend a conclusion about the rate of environment change.

### WORKPLACE COMPETENCY

#### ORGANIZATIONAL SKILLS: USING RESOURCES

Evaluate students on their ability to:

- identify a variety of resources
- use various resources appropriately
- complete a personal interview with an expert and use the information obtained in an appropriate manner.

# SCIENCE

## Academic Content Standard

4. Earth and Space Science: Students know and understand the processes and interactions of Earth s systems and the structure and dynamics of Earth and other objects in space.

4.3 Students know major sources of water, its uses, importance, and cyclic patterns of movement through the environment.

## Workplace Competencies

| GRADES 9-12 BENCHMARKS | COMMUNICATION SKILLS: Demonstrates the ability to receive and relay information clearly and effectively | | | | | | | ORGANIZATIONAL SKILLS: Demonstrates skills to effectively and efficiently operate within a workplace | | | | | | | THINKING SKILLS: Demonstrates the ability to use reasoning | | | | | | | TECHNOLOGY SKILLS: Demonstrates the ability to work with a variety of technologies | | | | WORKER QUALITIES: Demonstrates the characteristics of an effective worker | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Listening | Speaking | Reading | Writing | Interpreting | Negotiating | Persuading | Planning | Time Management | Using Resources | Systems Thinking | Evaluating | Problem Solving | Decision Making | Creative Thinking | Learning | Analyzing | Mathematics | Computer Literacy | Selects Technology | Applies Technology | Uses Technical Info. | Self Management | Team Member | Responsibility | Flexibility | Leadership | Diversity |
| a. identifying and explaining factors that influence the quality of water needed to sustain life | ● | ● | ● | | | | | | | ● | | ● | | | | * | | | | | | | | | | | | |
| b. identifying and analyzing the costs, benefits, and consequences of using water resources | | | | | | | | | | ● | | ● | | | | ● | ● | | | | | | | | | | | |
| c. explaining interactions between water and other Earth systems | ● | ● | ● | | | | | | | ● | | | | | | ● | | | | | | | | | | | | |
| d. explaining interrelationships between the circulation of oceans and weather and climate | ● | ● | ● | | | | | | | ● | | | | | | ● | | | | | | | | | | | | |

94

95

GRADE LEVEL

9-12

K 1 2 3 4 5 6 7 8 9 10 11 12

**STATE STANDARD**

4. Earth and Space Science: Students know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.
   4.3 Students know major sources of water, its uses, importance, and cyclic patterns of movement through the environment.

**BENCHMARK**

a. identifying and explaining factors that influence the quality of water needed to sustain life

**WORKPLACE COMPETENCY**

Thinking Skills: Analyzing
identifies bias of information sources, evaluates contradictory information and effectively manages information

## RESOURCE

The International Association for the Properties of Water and Steam (IAPWS) is an international non-profit association of national organizations concerned with the thermophysical properties of water and steam, particularly those properties of high-temperature steam, water and aqueous systems that are relevant to thermal power cycles and other industrial applications.

International Association for the Properties of Water and Steam
**http://www.iapws.org/**





## LEARNING ACTIVITIES

### ACADEMIC CONTENT STANDARD

Students create a diorama that depicts the water cycle and its interaction with the physical environment and organisms. The diorama should include the human interaction with water that can impact water quality such as run off, snow making, mining, development, etc.

### WORKPLACE COMPETENCY

#### THINKING SKILLS: ANALYZING

Students identify the skills needed in analyzing. Students identify experts with different opinions about an aspect of water quality (i.e., impact of global warming, need for conservation, impact of pollution, effectiveness of federal regulations to promote water quality, etc.). Students identify possible biases of the experts and reach their own opinion about the issue.

### CAREER DEVELOPMENT

Invite a guest speaker from the Department of Water Management, water board, or local Environmental Health Department to discuss conservation. The speaker also discusses the requirements of his/her field and describe various careers in the field or students use the internet to discover careers in this area.

### COMMUNITY

- Students create a poster showing the water cycle and the impact of pollution and increasing demand for water.
- Students display posters around the school about the importance of water conservation.
- Visit a water treatment plant or a wastewater treatment plant and interview the chemist who maintains the quality of the water supply.

## ASSESSMENTS

### ACADEMIC CONTENT STANDARD

Evaluate students on their ability to:
- create a diorama that accurately depicts the water cycle
- explain the process of the water cycle
- identify ways water is important to life
- describe the cause/effect relationships between types of human interactions that can impact water quality.

### WORKPLACE COMPETENCY

#### THINKING SKILLS: ANALYZING

Evaluate students on their ability to:
- locate a variety of expert opinions
- identify bias of information
- evaluate contradictory information sources
- reach and defend a conclusion based on the information.

### EXTENSIONS

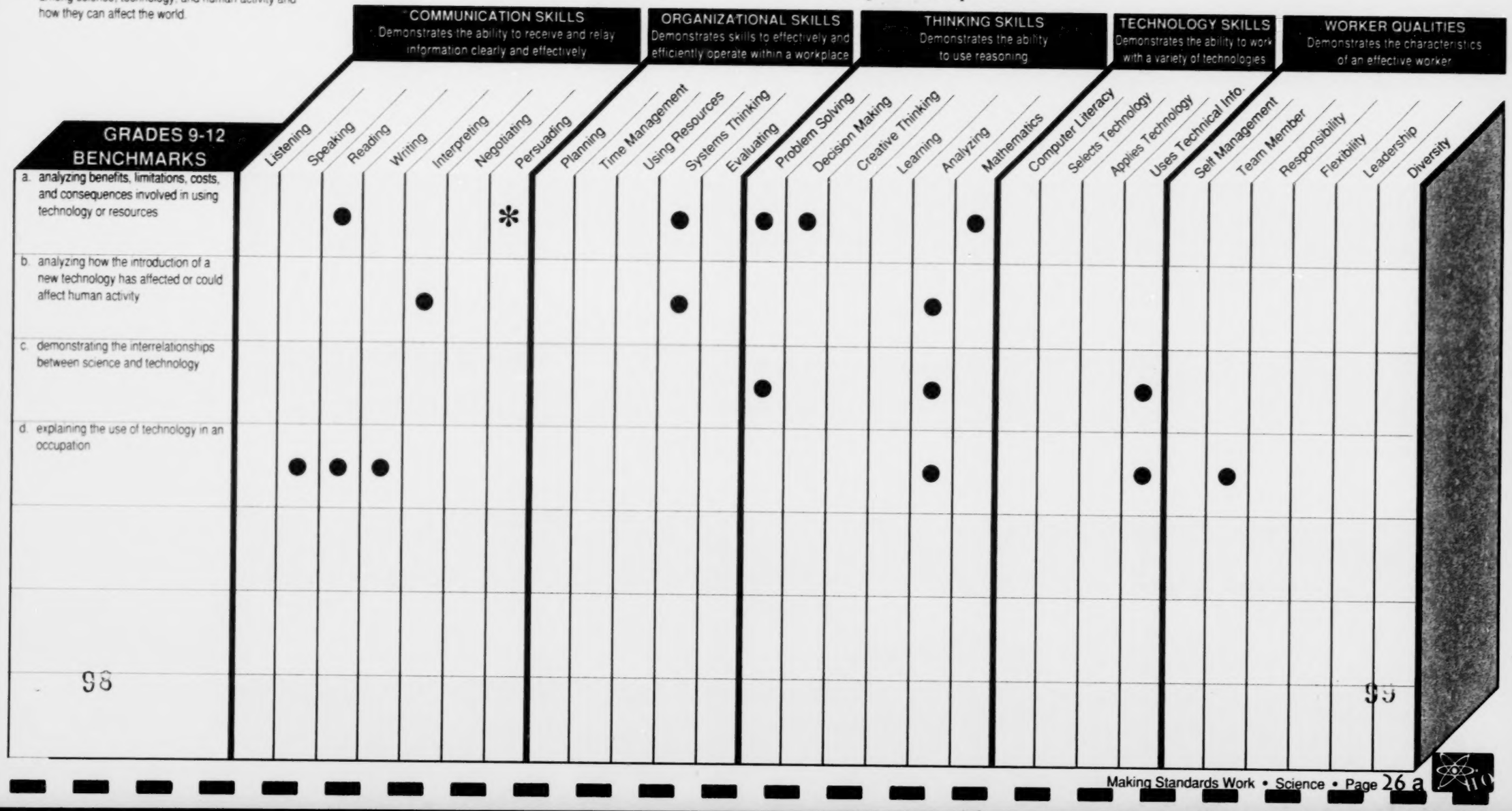
- Conduct water tests on water from different homes of different ages for lead.
- Conduct water tests on water from a nearby creek or pond. Test it for dissolved oxygen, PH, nitrates and phosphates.
- Use a spreadsheet program to graphically represent the results from the water tests.

# SCIENCE

## Academic Content Standard

5. Students know and understand interrelationships among science, technology, and human activity and how they can affect the world.

### Workplace Competencies



GRADE LEVEL **9-12**

K 1 2 3 4 5 6 7 8 9 10 11 12

**STATE STANDARD**

5. Students know and understand interrelationships among science, technology, and human activity and how they can affect the world.

**BENCHMARK**

a. analyzing benefits, limitations, costs, and consequences involved in using technology or resources

**WORKPLACE COMPETENCY**

Communication Skills: Persuading
communicates ideas to justify position, overcome resistance and convince others

## QUOTATION

"In the imaging business, we must create a bridge between the customer and a highly technical production environment. A high school graduate must have excellent communication skills (reading, writing, speaking and listening); a math and science background with Physics and Chemistry components; and an art background, with emphasis on the aesthetics of color and form, are requirements."

- Dan Avery, President
Heritage Imaging Services, Inc.



# SCIENCE

## LEARNING ACTIVITIES

### ACADEMIC CONTENT STANDARD

With hundreds millions of barrels of oil consumed each year in the USA alone to produce nitrogen fertilizer, students will evaluate alternatives for generating the necessary nutrients required to meet what is projected to be double the world food demand in the next twenty years. As well as the relationships between science, technology, and human activity. In small groups, students research the costs and risks to the environment in producing more fertilizers as opposed to creating new varieties of nitrogen-fixing plants. Finally, students will present their findings and persuade others as to the validity of their conclusions.

### WORKPLACE COMPETENCY

#### COMMUNICATION SKILLS: PERSUADING

The class discusses what makes a persuasive argument and identify several areas where the skill of persuasion is used. Students weigh the costs and benefits of each approach in providing food for the world needs. Among themselves, they will decide which approach to recommend and report their findings in a mock forum by role playing the various interests represented by this issue. Students then justify their stance, and use persuasion to convince other interested parties.

### CAREER DEVELOPMENT

Invite an agricultural chemist to report the current energy and environmental costs in producing nitrogen-based fertilizer. Invite a genetic engineer to speak about the prospects of engineering a new variety of nitrogen-fixing plants.

### COMMUNITY

As part of the mock forum, invite a farmer or rancher, petroleum engineer, chemist, power company and EPA representatives, water quality monitor, and bio-engineer to be present in addition to local governing authorities and community members. With each vested interest, students will be confronted with challenges to defend in their analysis and presentation.

## ASSESSMENTS

### ACADEMIC CONTENT STANDARD

Evaluate students on their ability to:

- demonstrate their understanding of relationships between science, technology, and human activity
- thoroughly research pertinent issues, benefits, limitations and consequences
- draw logical conclusions
- research, organize, analyze and present results.

### WORKPLACE COMPETENCY

#### COMMUNICATION SKILLS: PERSUADING

Evaluate students on their ability to:

- identify characteristics of persuasion and examples of and careers that utilize persuasion
- logically assess accumulated information
- evaluate contradictory information
- formulate and defend conclusions reasonably and soundly -- based on the findings and differing positions or points of view expressed.

### EXTENSIONS

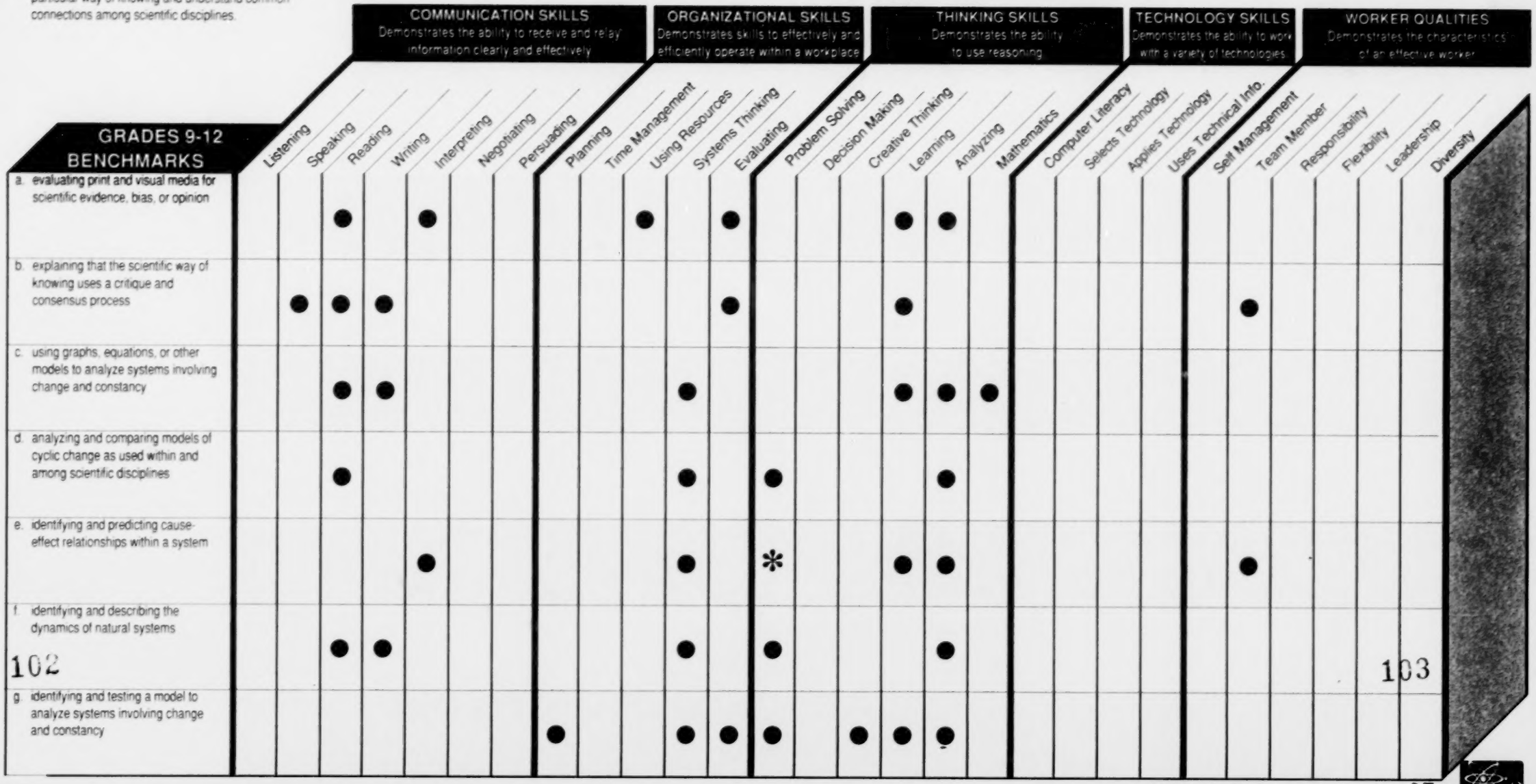
- This activity could be linked to social studies by focusing on the economics of each alternative.
- In a farming/ranching community, this activity could be linked to practical considerations of cost vs. yield for fertilizing a field of crops.

# SCIENCE

## Academic Content Standard

6. Students understand that science involves a particular way of knowing and understand common connections among scientific disciplines.

### Workplace Competencies


COMMUNICATION SKILLS
Demonstrates the ability to receive and relay information clearly and effectively
ORGANIZATIONAL SKILLS
Demonstrates skills to effectively and efficiently operate within a workplace
THINKING SKILLS
Demonstrates the ability to use reasoning
TECHNOLOGY SKILLS
Demonstrates the ability to work with a variety of technologies
WORKER QUALITIES
Demonstrates the characteristics of an effective worker
GRADES 9-12 BENCHMARKS
Listening
Speaking
Reading
Writing
Interpreting
Negotiating
Persuading
Planning
Time Management
Using Resources
Systems Thinking
Evaluating
Problem Solving
Decision Making
Creative Thinking
Learning
Analyzing
Mathematics
Computer Literacy
Selects Technology
Applies Technology
Uses Technical Info.
Self Management
Team Member
Responsibility
Flexibility
Leadership
Diversity
a. evaluating print and visual media for scientific evidence, bias, or opinion
b. explaining that the scientific way of knowing uses a critique and consensus process
c. using graphs, equations, or other models to analyze systems involving change and constancy
d. analyzing and comparing models of cyclic change as used within and among scientific disciplines
e. identifying and predicting cause-effect relationships within a system
f. identifying and describing the dynamics of natural systems
g. identifying and testing a model to analyze systems involving change and constancy

GRADE LEVEL

K 1 2 3 4 5 6 7 8 9 10 11 12

9-12

**STATE STANDARD**

6. Students understand that science involves a particular way of knowing and understand common connections among scientific disciplines.

**BENCHMARK**

e. identifying and predicting cause-effect relationships within a system

**WORKPLACE COMPETENCY**

Thinking Skills: Problem Solving
identifies and recognizes a problem, considers alternatives, devises and implements a logical plan of action

## RESOURCE

The National Science Teachers Association (NSTA), founded in 1944 and headquartered in Arlington, Virginia, is the largest organization in the world committed to promoting excellence and innovation in science teaching and learning for all. NSTA's current membership of more than 53,000 includes science teachers, science supervisors, administrators, scientists, business and industry representatives, and others involved in science education.

National Science Teachers Association
1840 Wilson Blvd.
Arlington, VA 22201-3000
703/243-7100
http://www.nsta.org





## LEARNING ACTIVITIES

### ACADEMIC CONTENT STANDARD

Students explore the relationship between increased heavy metal concentrations in water supplies and the aggravating effects of acid mine-drainage and acid preparation. Through research and experimentation, they identify the sources of heavy metal contamination and increased acidity in rainwater and predict consequences for the biosphere.

Students design laboratory experiments to detect the presence and concentration of heavy metal ions in water (chemistry) to investigate industrial causes of acid precipitation (chemistry and environmental science) and to explore the effects of heavy metal concentrations and acidity on fish populations (biology). Students interpret their results in combination with their research on the sources of such contaminants to predict environmental consequences and to propose mitigation efforts.

### WORKPLACE COMPETENCY

#### THINKING SKILLS: PROBLEM SOLVING

Students identify the steps in problem solving and examples of how we use this process in our daily lives. Students use these steps to conduct the scientific research experiment.

### CAREER DEVELOPMENT

Students enlist the assistance of experts in careers impacted by the scope of their study, such as:

- engineers (mining, powerplant, water treatment plant)
- environmental chemists
- wildlife managers
- EPA Super Fund Cleanup Supervisors

### COMMUNITY

Students research the sources of heavy metal, SOx and NOx emissions within their school and community and make recommendations for changing practices which would reduce the levels of each containment. Students engage in a service-learning project to conduct an on-going investigation of water quality in a local stream or river.

## ASSESSMENTS

### ACADEMIC CONTENT STANDARD

Evaluate the students on their ability to:

- demonstrate their understanding of the cause-effect relationship of heavy metal ions on organisms
- make reasonable conclusions about acids' ability to increase heavy metal concentrations, based on experimental results
- demonstrate their understanding of the cause-and-effect nature of the problem from source through the transport within the environment, to ultimate consequences.

### WORKPLACE COMPETENCY

#### THINKING SKILLS: PROBLEM SOLVING

Evaluate the students on their ability to:

- identify the steps in problem solving and give examples
- thoroughly research and identify sources of the problem
- consider alternatives and makes conclusions
- present a realistic plan of action.

### EXTENSIONS

Students write a short story describing a "worst case" scenario for runaway contamination which produces dire consequences for an imaginary community.

**B.S.C.S. (Biological Science Curriculum Study) has a 4 step problem solving model (I.D.E.A.):**
**I - identify the problem**
**D - describe the options**
**E - evaluate the options**
**A - arrive at a decision**

# IV. SAMPLE RUBRIC

**Standard 4 - Grades K-4**
This rubric is associated with the activity on Page 13b

| Assessment | In Progress | Essential | Proficient | Advanced |
|---|---|---|---|---|
| Academic Standard:<br>4). Earth and Space Science: Students know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.<br>4.2) Students know and understand the general characteristics of the atmosphere and fundamental processes of weather.<br>Benchmark:<br>a. Recognizing that the sun is a principal source of Earth's heat and light. | Academic Standard:<br>• Student is unable to state attributes of the sun, or the attributes given are unclear.<br>• Student is unable to correctly state the sun's relationship to other planets in the solar system.<br>• Student can not state accurately both a positive and a negative influence that the sun has on the earth.<br>• Student attempts to measure air temperature above the soil in the cups. Data and graph are incomplete or inaccurate. | Academic Standard:<br>Students:<br>• Student can state at least one accurate attribute of the sun.<br>• Student can state that the sun provides light and heat energy to the earth.<br>• Student can identify at least one positive and negative influence the sun has on the earth.<br>• Student measures a temperature above the soil in the cups. Data may be incomplete. Graph may have several errors. | Academic Standard:<br>Students:<br>• Student can state at least 3 attributes of the sun.<br>• Student can accurately place the sun at the center of solar system and state that the sun provides light and heat energy to the earth.<br>• Student can identify at least 2 positive and negative influences the sun has on the earth.<br>• Student accurately measures air temperature above the soil in the cups for 30 minutes. Data may be incomplete for the five-minute intervals. Graph may display minor errors. | Academic Standard:<br>Students:<br>• Student can state 5 or more attribute of the sun.<br>• Student can accurately place the sun at the center of the solar system and can state that the sun provides light and heat energy to the earth and to other planets.<br>• Student can identify 3 or more positive and negative influences the sun has on the earth.<br>• Student accurately measures the air temperatures above the soil placed in cups every 5 minutes for 30 minutes. Data is complete. Data is plotted accurately on a graph. |
| Workplace Competency:<br>Organizational Skills: Systems Thinking<br>understands the nature of systems, develops and adapts systems to meet organizational needs. | Workplace Competency:<br>• Student is unsure that there was a difference between air temperatures above the soil cups. Student has difficulty using temperature data to support 'why' there should be a difference in temperatures. | Workplace Competency:<br>• Student states that there was a difference of air temperature between the 2 cups.<br>• Student attempts to describe 'why' the difference was detected but the statement may not be based on the data collected. | Workplace Competency:<br>• Student states a difference of air temperature between the 2 cups & describes this difference using data collected.<br>• Student uses the difference between the two cups (one cup of soil sealed in a bag and the other not) within their stated conclusion. | Workplace Competency:<br>• Student states a difference of air temp. between the 2 cups and explains the difference using a cause-effect relationship (such as), "because one cup of soil was sealed in a bag (closed system), the air temp. increased. Since the other cup was not and had regular air above it (open system), the temp. did not increase as much."<br>• Student demonstrates systems thinking using the organized test results. |

# IV. SAMPLE RUBRIC

**Standard 1 - Grades 5-8**
This rubric is associated with the activity on Page 16b

| Assessment | In Progress | Essential | Proficient | Advanced |
|---|---|---|---|---|
| Academic Standard:<br>1). Students understand the process of scientific investigation and design, conduct, communicate about and evaluate such investigations.<br>e. using appropriate tools, technologies, and measurement units to gather and organize data. | Academic Standard:<br>• Experiment directions were not followed for successful results. Experiment was not completed.<br>• The hypothesis is not stated or is unclear.<br>• Observations are not listed or are insufficient.<br>• Further investigative questions are missing or are insufficient to develop a new hypothesis.<br>• No new hypothesis is stated. | Academic Standard:<br>• Experiment directions were followed with some steps being skipped or some steps being rushed through.<br>• Hypothesis is stated but may not lead to observable results.<br>• Five or less observations are listed. Observations may not be detailed or be differentiated.<br>• One investigative questions is given. Question may be unclear or be too similar to the original hypothesis. Question may not be based on observations.<br>• A new hypothesis is stated but may not lead to observable results or may be too similar to the original hypothesis. | Academic Standard:<br>• Experiment directions were followed to completion.<br>• A hypothesis is stated at the beginning of the investigation.<br>• At lease seven differentiated, understandable, and detailed observations are listed.<br>• At least one investigative question is listed.<br>• A new hypothesis is stated. | Academic Standard:<br>• Experiment directions were followed in a systematic, step-by-step, and complete manner.<br>• A hypothesis is clearly stated at the beginning of the investigation.<br>• At least ten or more differentiated, understandable, and detailed observations are listed.<br>• At least two or more clear and understandable investigative questions are listed. Questions are based on recorded observations.<br>• A new hypothesis is clearly stated and is based upon the investigative questions. |
| Workplace Competency:<br>Technology Skills: Selects Technology chooses appropriate procedures, tools or equipment | Workplace Competency:<br>• The group can not choose the appropriate technology tool for completion of the lab report before the deadline given.<br>• The group has an incomplete lab report. Missing some sections and pictures. | Workplace Competency:<br>• The group chooses the appropriate technology too! for completion of the lab report by the given deadline.<br>• The group has a very basic lab report but does not adhere to the required format. Several spelling and grammatical errors may exist. At least one section may be missing and only one picture is included. | Workplace Competency:<br>• The group chooses the appropriate tool for completion of the lab report before the given deadline.<br>• The group has a completed report and followed the required format. Minor spelling and grammatical errors may exist. The report includes all required sections and at least three pictures. | Workplace Competency:<br>• The group chooses the appropriate technology tool for completion of the lab report well before the deadline and may use time outside of class to work.<br>• The group has a complete lab report following the required format. Few, if any, spelling and grammatical errors exist. The report includes all required sections and five or more pictures. |

# IV. SAMPLE RUBRIC

**Standard 1 - Grades 9-12**
This rubric is associated with the activity on Page 22b

| Assessment | In Progress | Essential | Proficient | Advanced |
|---|---|---|---|---|
| Academic Standard:<br>1). Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.<br>b. creating and defending a written plan of action for a scientific investigation. | Academic Standard:<br>• Investigative process was not followed for successful results. Investigation was not completed.<br>• Observations based on witness interviews and visits to the crime scene are not listed or are insufficient.<br>• Data from physical testing are not given or are insufficient.<br>• Stated conclusion is weak and not fully based on the gathered supporting evidence. | Academic Standard:<br>• Investigation process followed with some steps being skipped or some steps being rushed through.<br>• Five or fewer observations based on witness interviews and visits to the crime scene are recorded. Observations may lack details.<br>• Data table showing analysis of physical testing is incomplete or inaccurate.<br>• Conclusion is stated but may be inaccurate and not based fully on all the evidence gathered. | Academic Standard:<br>• Investigation process followed to completion.<br>• At least seven observations based on witness interviews and visits to the crime scene are recorded. Details mostly given.<br>• Data table shows analysis of at least three physical laboratory tests. Results accurately displayed.<br>• Conclusion demonstrates analysis of most of the given observations and experimental testing. | Academic Standard:<br>• Investigation process was followed in a systematic, step-by-step and complete manner.<br>• Ten or more observations based on witness interviews and visits to the crime scene are accurately and clearly recorded. Details are given.<br>• Data table shows analysis of five or more laboratory results of physical tests. Results are neatly and accurately displayed.<br>• Conclusion demonstrates analysis of all given observations and experimental testing. |
| Workplace Competency:<br>Communication Skills: Interpreting delineates, and analyzes oral and written information and synthesizes information into a conclusion | Workplace Competency:<br>• In a written report, the given statement to defend the conclusion is incomplete or simply "guessed" at.<br>• Little or no systematic thinking is demonstrated within the written conclusion using an investigative "process of elimination" technique. | Workplace Competency:<br>• In a written report, the given statement to defend the conclusion is based on some of the gathered observations and physical testing. The method of "guessing" may be apparent due to an incomplete investigation.<br>• The conclusion is attempted but inadequately defended using higher-order thinking skills (analysis and synthesis). | Workplace Competency:<br>• In a written report, the given statement to defend the conclusion is based on an analysis and synthesis of at least seven pieces of evidence gathered during the investigative process.<br>• The conclusion is defended by presenting evidence that eliminates who "didn't do it", but may be insufficient (process of elimination). | Workplace Competency:<br>• In a written report, the given statement to defend the conclusion is based on a synthesis of ten or more pieces of evidence gathered during the investigative process.<br>• The conclusion is defended by presenting evidence that clearly supports who "didn't do it"; process of elimination and systems thinking are demonstrated. |

# SCHOOL-TO-CAREER REGIONAL RESOURCE CENTERS

The following resource centers were created to support Colorado communities in building local School-to-Career Partnerships. This support includes: materials, technical support, orientation and specific content presentations, and professional development opportunities. Please contact the center in your area for more information.

**Region 1 - Northern Colorado**
**Connie Long**
Aims Community College
Continuing Education Division
5590 11th Street
Greeley, CO 80634
Phone: (970) 330-8008 X6740
E-Mail: connie_long@ceo.cudenver.edu
(Counties: Larimer, Weld, Morgan, Logan, Sedgwick, Phillips, Washington, Yuma Elbert, Lincoln, Kit Carson, and Cheyenne)

**Region 2 - Denver/Metro**
**Gary Price & Alice Potter**
School-to-Career Resource Center
Community College of Denver
P.O. Box 173363
Campus Box 614
Denver, CO 80217-3363
Phone: (303) 556-2592
E-Mail: gary_g._price @ ceo.cudenver.edu OR alice_potter@ceo.cudenver.edu
(Counties: Adams, Arapahoe, Boulder, Gilpin, Clear Creek, Jefferson, Denver, Douglas)

**Region 3 - Central Colorado**
**Ed Bowen**
Pikes Peak Community College
5675 South Academy Boulevard, Box 38
Colorado Springs, CO 80906
Phone: (719) 540-7357
E-Mail: stc@ppcc.cccoes.edu
(Counties: Park, Chaffee, Teller, El Paso, Fremont, Custer, Pueblo)

**Region 4 - Southern Colorado**
**Julie Sumpter**
Otero Junior College
1802 Colorado Avenue
La Junta, CO 81050
Phone: (719) 384-6835
E-Mail: julie.sumpter@ojc.cccoes.edu
(Counties: Crowley, Kiowa, Otero, Bent, Prowers, Baca, Las Animas, Huerfano, Costilla, Alamosa, Conejos, Rio Grande, Mineral, Saguache)

**Region 5 - Southwestern Colorado**
**Barbara Milicevic**
9 West Main
Cortez, CO 81321
Phone: (970) 565-7717
E-Mail: stcrv@fone.net
(Counties: Delta, Gunnison, Montrose, Ouray, San Miguel, Dolores, San Juan, Hinsdale, Montezuma, La Plata)

**Region 6 - Western Colorado**
**Gail Smith**
P.O. Box 4548
Frisco, CO 80443
Phone: (970) 668-1120
E-Mail: gail_smith@ceo.cudenver.edu
(Counties: Moffat, Routt, Jackson, Grand, Summit, Eagle, Lake, Pitkin, Mesa, Garfield, Rio Blanco)

# MAKING STANDARDS WORK EVALUATION

The Colorado Department of Education and The Colorado School-to-Career Partnership would appreciate your comments about *Making Standards Work* Handbooks.

Please take a minute to complete this evaluation.

Name _____ (optional) Position _____

School District _____

Grade Level: Elem. ____ Middle School ____ High School ____ Other _____

I. Overall value of handbook:

| | | Poor | Fair | Good | Excellent |
|---|---|---|---|---|---|
| 1. | Quality of information | 1 | 2 | 3 | 4 |
| 2. | Usefulness for educators | 1 | 2 | 3 | 4 |
| 3. | Format of information | 1 | 2 | 3 | 4 |

II. Any comments about how you adapted the learning activities to meet your needs.

III. Number of students impacted by the classroom activities presented in this handbook. Approximately: _____

IV. Any suggestions for extending the use of this book?
(for example: other areas of interest, additional activities, distribution)

VI. Are you a *Making Standards Work* author? Yes _____ No _____

To request additional copies of the Geography Handbook, please contact:

Career & Technical Education Resource Center of Colorado
1059 Yosemite Street, Bldg. 758, Room 117
Aurora, CO 80010
phone: (303) 340-7350
fax: (303) 340-7353
www.cterc.cccoes.edu

Or E-mail: cterc@cccs.cccoes.edu

***Thank you.***

Colorado Department of Education
Attention: Heather Hotchkiss/Kelli Roark
201 East Colfax, Room 502
Denver, CO 80203

Staple Here

=====

**Colorado Department of Education**
201 East Colfax Avenue
Denver, Colorado 80203
(303) 866-6600
http://www.cde.state.co.us

**Colorado School-to-Career Partnership**
1580 Logan Street, Suite 410
Denver, Colorado 80203
(303) 894-2060 ★ Fax: (303) 894-2064
http://www.cde.state.co.us/cdesarh/public/s-t-c.htm